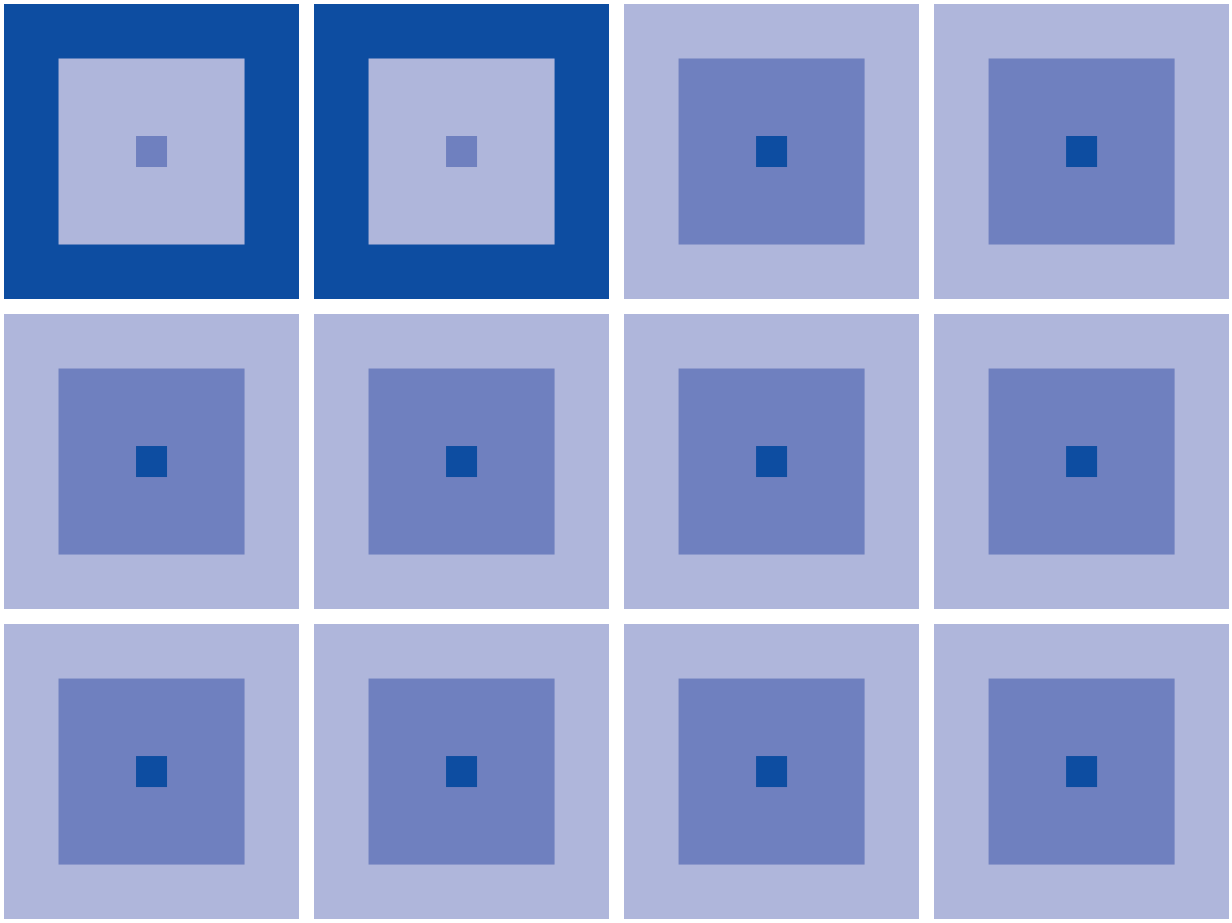
MF599-06

EPSON

CMOS 4-BIT SINGLE CHIP MICROCOMPUTER

# S1C62 Family

# Development Tool Reference Manual



SEIKO EPSON CORPORATION

ENERGY SAVING EPSON

***NOTICE***

*No part of this material may be reproduced or duplicated in any form or by any means without the written permission of Seiko Epson. Seiko Epson reserves the right to make changes to this material without notice. Seiko Epson does not assume any liability of any kind arising out of any inaccuracies contained in this material or due to its application or use in any product or circuit and, further, there is no representation that this material is applicable to products requiring high level reliability, such as medical products. Moreover, no license to any intellectual property rights is granted by implication or otherwise, and there is no representation or warranty that anything made in accordance with this material will be free from any patent or copyright infringement of a third party. This material or portions thereof may contain technology or the subject relating to strategic products under the control of the Foreign Exchange and Foreign Trade Law of Japan and may require an export license from the Ministry of International Trade and Industry or other approval from another government agency.*

# S1C62 Family Development Tool Reference Manual

## *Preface*

The explanation covering the outline and operation of the development support tools for the CMOS 4-bit Single Chip Microcomputer S1C62 Family has been divided into the following parts.

**I. INTRODUCTION**
**II. DEVELOPMENT TOOL MANAGEMENT SYSTEM DMS6200**
**III. CROSS ASSEMBLER ASM62XX**
**IV. MELODY ASSEMBLER MLA628X**
**V. FUNCTION OPTION GENERATOR FOG62XX**
**VI. SEGMENT OPTION GENERATOR SOG62XX**
**VII. EVALUATION BOARD S5U1C62XXXE**
**VIII. ICE CONTROL SOFTWARE ICS62XX**
**IX. MASK DATA CHECKER MDC62XX**

## *Before Reading . . .*

This manual indicates the model name as "S1C62XXX" and source file and output files as "C2XXYYY" for purposes of explanation of the common content in each model of the S1C62 Family. You should substitute the "XXX" parts for the various model names. Please allow Seiko Epson to specify the "YYY" section for each customer.

Example: When the development model is S1C6S460, and the "YYY" section is to be specified as "0A0".

S1C6XXXX → S1C6S460
CXXXYYY → CS460A0

## *Reference Manual*

The peculiar content of each model, device details and the like are explained in the below manual. You should refer to it as required.

| | | |
|---|---|---|
| *Development Tools* | ☞ | S5U1C62xxxD Manual (Development Software Tool for S1C62xxx)<br>S5U1C62xxxE Manual (Evaluation Board for S1C62xxx)<br>S5U1C62000H Manual (S1C60/62 Family In-Circuit Emulator) |
| *Device (S1C62xxx)* | ☞ | S1C62xxx Technical Manual |
| *Instructions* | ☞ | S1C6200/6200A Core CPU Manual |

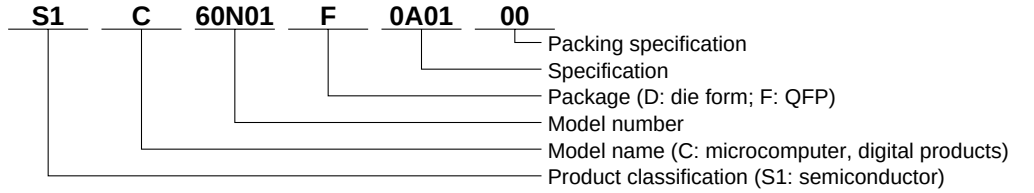
* In this manual, "ICE" and "evaluation board" indicate S5U1C62000H and S5U1C62xxxE, respectively.

## The information of the product number change

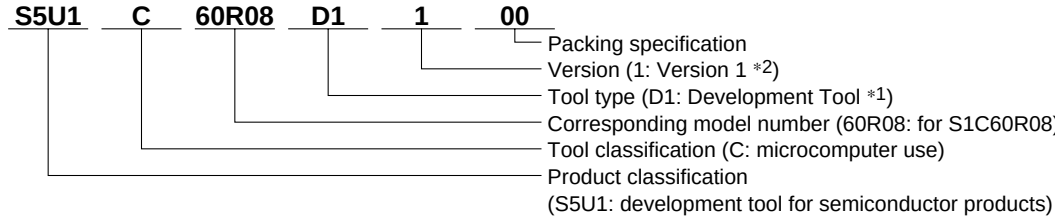
Starting April 1, 2001, the product number will be changed as listed below. To order from April 1, 2001 please use the new product number. For further information, please contact Epson sales representative.

## Configuration of product number

Devices




Development tools




*1: For details about tool types, see the tables below. (In some manuals, tool types are represented by one digit.)
*2: Actual versions are not written in the manuals.

## Comparison table between new and previous number

S1C60 Family processors

| Previous No. | New No. |
|---|---|
| E0C6001 | S1C60N01 |
| E0C6002 | S1C60N02 |
| E0C6003 | S1C60N03 |
| E0C6004 | S1C60N04 |
| E0C6005 | S1C60N05 |
| E0C6006 | S1C60N06 |
| E0C6007 | S1C60N07 |
| E0C6008 | S1C60N08 |
| E0C6009 | S1C60N09 |
| E0C6011 | S1C60N11 |
| E0C6013 | S1C60N13 |
| E0C6014 | S1C60140 |
| E0C60R08 | S1C60R08 |

S1C62 Family processors

| Previous No. | New No. |
|---|---|
| E0C621A | S1C621A0 |
| E0C6215 | S1C62150 |
| E0C621C | S1C621C0 |
| E0C6S27 | S1C6S2N7 |
| E0C6S37 | S1C6S3N7 |
| E0C623A | S1C6N3A0 |
| E0C623E | S1C6N3E0 |
| E0C6S32 | S1C6S3N2 |
| E0C6233 | S1C62N33 |
| E0C6235 | S1C62N35 |
| E0C623B | S1C6N3B0 |
| E0C6244 | S1C62440 |
| E0C624A | S1C624A0 |
| E0C6S46 | S1C6S460 |

| Previous No. | New No. |
|---|---|
| E0C6247 | S1C62470 |
| E0C6248 | S1C62480 |
| E0C6S48 | S1C6S480 |
| E0C624C | S1C624C0 |
| E0C6251 | S1C62N51 |
| E0C6256 | S1C62560 |
| E0C6292 | S1C62920 |
| E0C6262 | S1C62N62 |
| E0C6266 | S1C62660 |
| E0C6274 | S1C62740 |
| E0C6281 | S1C62N81 |
| E0C6282 | S1C62N82 |
| E0C62M2 | S1C62M20 |
| E0C62T3 | S1C62T30 |

## Comparison table between new and previous number of development tools

Development tools for the S1C60/62 Family

| Previous No. | New No. |
|---|---|
| ASM62 | S5U1C62000A |
| DEV6001 | S5U1C60N01D |
| DEV6002 | S5U1C60N02D |
| DEV6003 | S5U1C60N03D |
| DEV6004 | S5U1C60N04D |
| DEV6005 | S5U1C60N05D |
| DEV6006 | S5U1C60N06D |
| DEV6007 | S5U1C60N07D |
| DEV6008 | S5U1C60N08D |
| DEV6009 | S5U1C60N09D |
| DEV6011 | S5U1C60N11D |
| DEV60R08 | S5U1C60R08D |
| DEV621A | S5U1C621A0D |
| DEV621C | S5U1C621C0D |
| DEV623B | S5U1C623B0D |
| DEV6244 | S5U1C62440D |
| DEV624A | S5U1C624A0D |
| DEV624C | S5U1C624C0D |
| DEV6248 | S5U1C62480D |
| DEV6247 | S5U1C62470D |

| Previous No. | New No. |
|---|---|
| DEV6262 | S5U1C62620D |
| DEV6266 | S5U1C62660D |
| DEV6274 | S5U1C62740D |
| DEV6292 | S5U1C62920D |
| DEV62M2 | S5U1C62M20D |
| DEV6233 | S5U1C62N33D |
| DEV6235 | S5U1C62N35D |
| DEV6251 | S5U1C62N51D |
| DEV6256 | S5U1C62560D |
| DEV6281 | S5U1C62N81D |
| DEV6282 | S5U1C62N82D |
| DEV6S27 | S5U1C6S2N7D |
| DEV6S32 | S5U1C6S3N2D |
| DEV6S37 | S5U1C6S3N7D |
| EVA6008 | S5U1C60N08E |
| EVA6011 | S5U1C60N11E |
| EVA621AR | S5U1C621A0E2 |
| EVA621C | S5U1C621C0E |
| EVA6237 | S5U1C62N37E |
| EVA623A | S5U1C623A0E |

| Previous No. | New No. |
|---|---|
| EVA623B | S5U1C623B0E |
| EVA623E | S5U1C623E0E |
| EVA6247 | S5U1C62470E |
| EVA6248 | S5U1C62480E |
| EVA6251R | S5U1C62N51E1 |
| EVA6256 | S5U1C62N56E |
| EVA6262 | S5U1C62620E |
| EVA6266 | S5U1C62660E |
| EVA6274 | S5U1C62740E |
| EVA6281 | S5U1C62N81E |
| EVA6282 | S5U1C62N82E |
| EVA62M1 | S5U1C62M10E |
| EVA62T3 | S5U1C62T30E |
| EVA6S27 | S5U1C6S2N7E |
| EVA6S32R | S5U1C6S3N2E2 |
| ICE62R | S5U1C62000H |
| KIT6003 | S5U1C60N03K |
| KIT6004 | S5U1C60N04K |
| KIT6007 | S5U1C60N07K |

# I

## S1C62 FAMILY DEVELOPMENT TOOL

# INTRODUCTION

This part explains the composition of the development support tool for the 4-bit Single Chip Microcomputer S1C62 Family and the developmental environment.

# INTRODUCTION

## Contents

# 1 TYPES OF DEVELOPMENT SUPPORT TOOLS

Here we will explain the composition of the software and hardware for the development support tools.

## 1.1 Composition of the Software Development Tools S5U1C62xxxD

The below software are included in the software development support tools used in each S1C62XXX model.

1. Development Tool Management System DMS6200 .. Menu selections for each software / start-up software
2. Cross Assembler ASM62XX ..... Cross assembler for program preparation
3. Melody Assembler MLA628X (Note) ..... Melody data preparation program
4. Function Option Generator FOG62XX ..... Function option data preparation program
5. Segment Option Generator SOG62XX (Note) ..... Segment option data preparation program
6. ICE Control Software ICS62XX ..... ICE control program
7. Mask Data Checker MDC62XX ..... Mask data preparation program

*Note The 3 Melody Assembler MLA628X are only set in the models (S1C62N8X) that have melody functions.*
*The 5 Segment Option Generator SOG62XX are only set in models that have LCD driver and segment options.*

## 1.2 Composition of the Hardware Tools

The following two types have been prepared for all types as hardware development support systems.

1. In-Circuit Emulator S5U1C62000H..... In-circuit emulator permitting high level debugging (common to each model)
2. Evaluation Board S5U1C62xxxE ..... Evaluation board that has the same functions as the actual IC (different for each model)

# 2 DEVELOPMENTAL ENVIRONMENT

The software product of the development support tool S5U1C62xxxD operates on the following host systems:

- IBM PC/AT (at least PC-DOS Ver. 2.0)

When developing the S1C62XXX, the above-mentioned host computer, editor, P-ROM writer, printer, etc. must be prepared by the user in addition to the development tool which is normally supported by Seiko Epson.

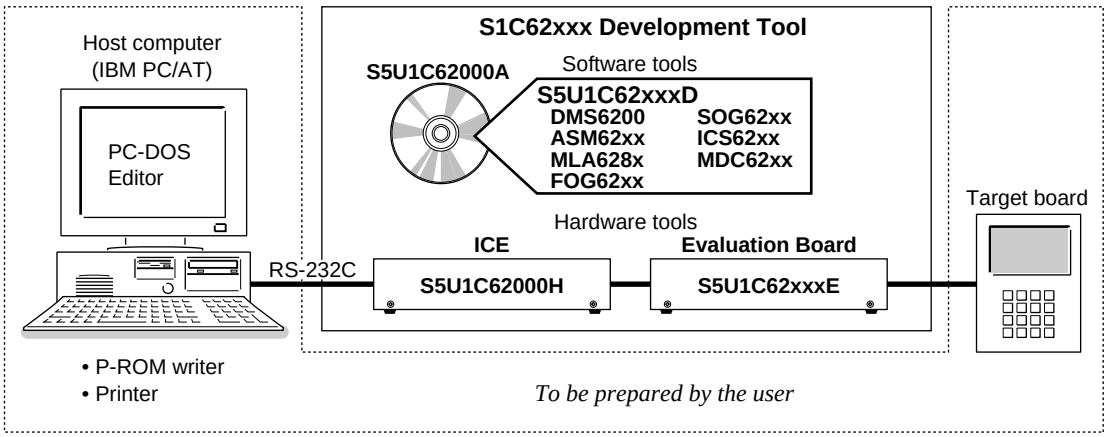



*Fig. 2.1 System configuration*

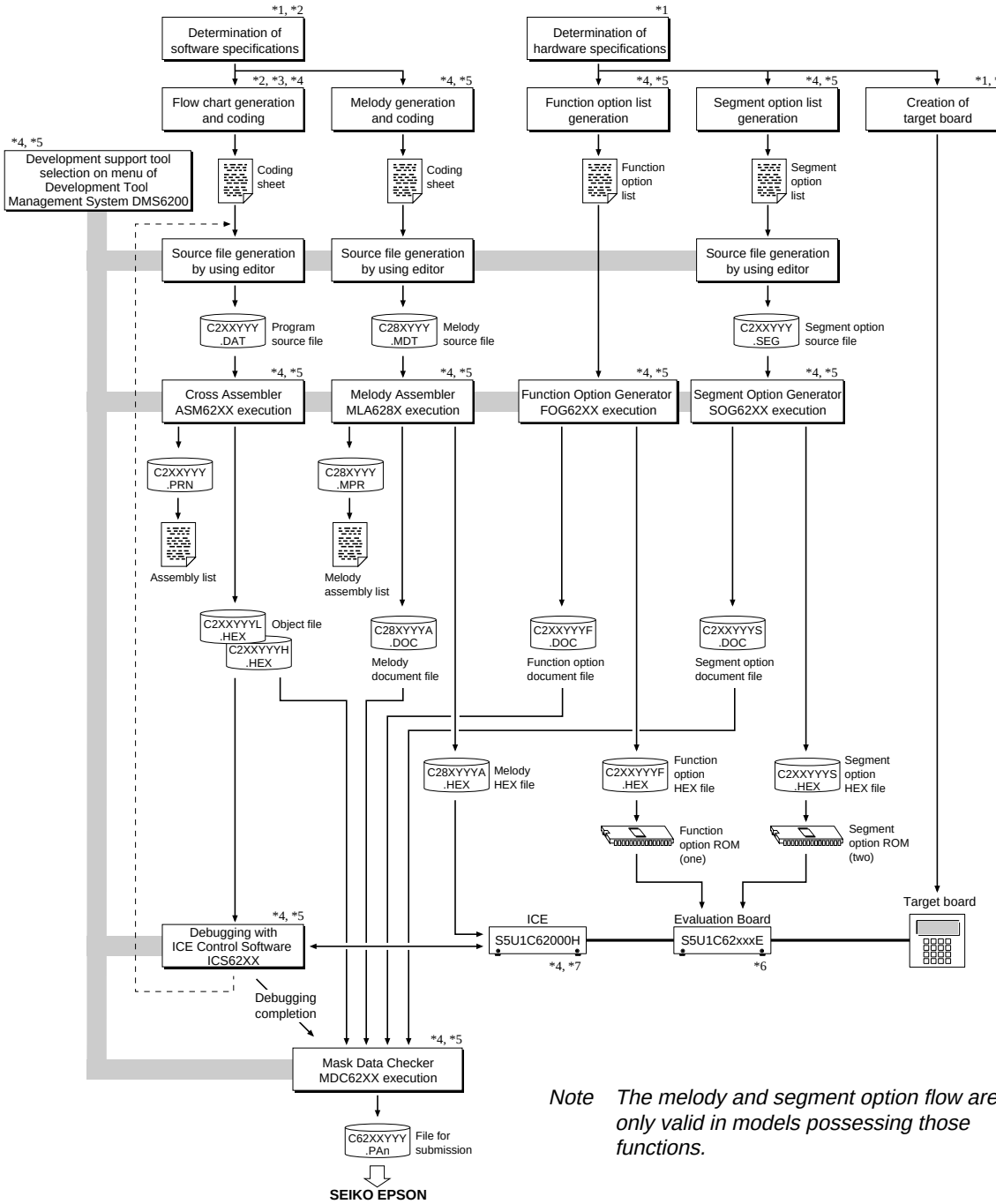
*Note The S5U1C62xxxD system requires a host computer with a RAM capacity of about 140K bytes. Since the ICE (S5U1C62000H) is connected to the host computer with a RS-232C serial interface, adapter board for asynchronous communication will be required depending on the host computer used.*

# 3 DEVELOPMENT FLOW

Figure 3.1 shows the development flow through the S5U1C62xxxD.

### Concerning file names

All the input-output file name for the each development support tool commonly use "C2XXYYY". In principle each file should be produced in this manner. Seiko Epson will designate the "YYY" for each customer.




*Note The melody and segment option flow are only valid in models possessing those functions.*

*Fig. 3.1 S5U1C62xxxD development flow*

## ☞ Reference manual

*1 S1C62xxx Technical Manual (Hardware)
*2 S1C62xxx Technical Manual (Software)
*3 S1C6200/6200A Core CPU Manual
*4 S1C62 Family Development Tool Reference Manual (this manual)
*5 S5U1C62xxxD Manual
*6 S5U1C62xxxE Manual
*7 S5U1C62000H Manual

# 4 INSTALLATION

The S5U1C62xxxD tools are included on the CD-ROM of the S5U1C62000A (S1C60/62 Family Assembler Package), and they can be installed in your hard disk using the installer (Setup.exe) on the CD-ROM. Refer to the "S5U1C62000A Manual" for how to install the S5U1C62xxxD tools.

*Note* *The DMS6200 configures a menu from files that are located in the current directory. Therefore, do not move the development tools from the directory in which the DMS6200 exists.*
*To invoke an editor (DOS version) or other programs from the DMS6200, copy those executable files to the directory in which the DMS6200 exists.*

# 5 DIFFERENCES FROM MODEL TO MODEL AND PRECAUTIONS

There may be some models in which the following two types software tools contained in the S5U1C62xxxD are not included.

(1) Segment Option Generator SOG62XX
This is not included in the software tools of models in which the segment option has not been set.

(2) Melody Assembler MLA628X
This is not included in the software tools for the models (Other than S1C62N8X) that do not have the melody function.

Please be aware of the following points in setting the host system.

(1) The S5U1C62xxxD system requires a host computer with a RAM capacity of about 140K bytes.

(2) Since the ICE is connected to the host computer with a RS-232C serial interface, adapter board for asynchronous communication will be required depending on the host computer used.

(3) In order for the MDC62XX to handle numerous files, set the number of files described in the CONFIG.SYS to 10 or more (e.g., FILES = 20).

# 6 TROUBLESHOOTING

| Tool | Problem | Remedy measures |
|---|---|---|
| ICE<br>S5U1C62000H | Nothing appears on the screen, or nothing works, after activation. | Check the following and remedy if necessary:<br>• Is the RS-232C cable connected correctly?<br>• Is the RS-232C driver installed?<br>• Is MODE.COM on the disk?<br>• Is the execution file correct?<br>PC-DOS ICS62XXW.EXE<br>• Is the DOS version correct?<br>PC-DOS Ver. 2.1 or later<br>• Is the DIP switches that set the baud rate of the main ICE unit set correctly?<br>• Is the fuse of the ICE cut off? |
| | The ICE fuse cut immediately after activation. | Check the following and remedy if necessary:<br>• Are connectors F1 and F5 connected to the evaluation board correctly?<br>• Is the target board power short-circuiting? |
| | <ILLEGAL VERSION ICE6200> appears on the screen immediately after activation. | The wrong version of ICE is being used. Use the latest version. |
| | <ILLEGAL VERSION PARAMETER FILE> appears on the screen immediately after activation. | The wrong version of ICS62XXP.PAR is being used. Use the latest version. |
| | Immediate values A (10) and B (11) cannot be entered correctly with the A command. | The A and B registers are reserved for the entry of A and B. Write 0A and 0B when entering A (10) and B (11).<br>*Example:* `LD A, B` Data in the B register is loaded into the A register.<br>`LD B, 0A` Immediate value A is loaded into the B register. |
| | <UNUSED AREA> is displayed by the SD command. | This massage is output when the address following one in which data is written is unused. It does not indicates problem. Data is correctly set in areas other than the read-only area. |
| | You can not do a real-time run in break-trace mode. | Since the CPU stops temporarily when breaking conditions are met, executing in a real-time is not performed. |
| | Output from the evaluation board is impossible when data is written to the I/O memory for Buzzer and Fout output with the ICE command. | Output is possible only in the real-time run mode. |
| SOG62XX | An R error occurs although the address is correctly set in the segment source file. | Check the following and remedy if necessary:<br>• Does the address symbol use capital letters?<br>• Are the output ports set for every two terminals? |

| Tool | Problem | Remedy measures |
|---|---|---|
| ASM62XX | An R error occurs although the final page is passed. | The cross assembler is designed to output "R error" every time the page is changed. Use a pseudo-instruction to set the memory, such as ORG or PAGE, to change the page. See "Memory setting pseudo-instructions" in the cross assembler manual. |
| MDC62XX | Activation is impossible. | Check the following and remedy if necessary:<br>• Is the number of files set at ten or more in OS environment file CONFIG.SYS? |
| MLA628X | No melody is output. | Check the following and remedy if necessary:<br>• Has the OPTLD command of the ICE been executed? (When the ICE is connected to the evaluation board)<br>• Is the MELODY ROM installed? (When the evaluation board is used independently)<br>• Is the attack bit of the melody data set to "1"? |
| Evaluation board<br>S5U1C62xxxE | The evaluation board does not work when it is used independently. | Check the following and remedy if necessary:<br>• Has the EPROM for F.HEX and S.HEX been replaced by the EPROM for the target?<br>• Is the EPROM for F.HEX and S.HEX installed correctly?<br>• Is the appropriate voltage being supplied? (5V DC, 3 A, or more)<br>• Are the program ROMs (H and L) installed correctly?<br>• Is data written from address 4000H? (When the 27C256 is used as the program ROM)<br>• Is the EN/DIS switch on the evaluation board set to EN? |
| | Target segment does not light. | Check the following and remedy if necessary:<br>• Is an EPROM with an access time of 170 ns or less being used for S.HEX.<br>• Has the VADJ VR inside the evaluation board top cover been turned to a lower setting? |

# II

## DEVELOPMENT TOOL MANAGEMENT SYSTEM

# DMS6200

This part mainly explains how to operate the Development Tool Management System DMS6200.

# DEVELOPMENT TOOL MANAGEMENT SYSTEM

## Contents

# 1 DIFFERENCES DEPENDING ON THE MODEL

The DMS6200 is a software tool that is common to the all models of the S1C62 Family and there is no difference in operating procedure. However, the content of such things as the menu screen may vary due to differences in the configuration of the software for each model and differences in the directory content in the DMS6200.
The below two types that are included in the explanation and display screen examples may not be present in certain models.

(1) The SOG62XX and C2XXYYYS.* are only available in models offering the segment option.
(2) The MLA628X, C28XYYY.M* and C28XYYYA.* are only available in models offering the melody function.

When models that do not have the above functions are used, disregard the respective program names and file names indicated in the manual.
Refer to the "S5U1C62xxxD Manual" for the software tools included in the S5U1C62xxxD.

# 2 DMS6200 OUTLINE

The DMS6200 (Development Tool Management System) is a software which selects the S5U1C62xxxD software development support tool and the program such as an editor in menu form and starts it.
In this way the various software frequently executed during debugging can be effectively activated.

Figure 2.1 shows the DMS6200 execution flow.

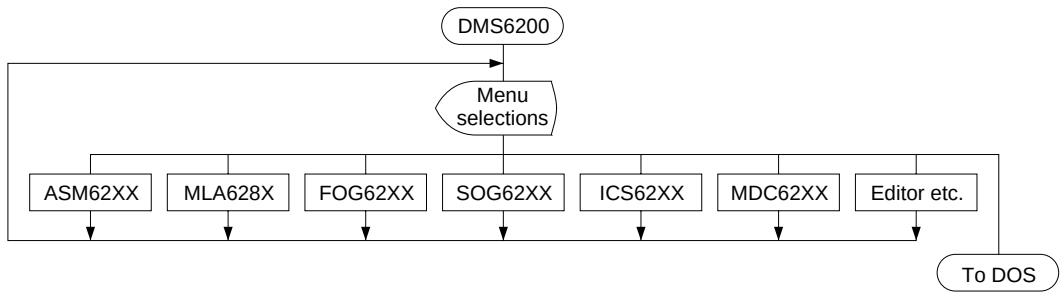



*Fig. 2.1 DMS6200 execution flow*

# 3 DMS6200 OPERATION PROCEDURE

Set the directory containing the respective software development support tools into the current directory prior to activating the DMS6200.
Since the development support tools each require input files (e.g., source file), first create the input files according to the support tool manuals and then perform the following operations:

(1) The following is entered on the current drive:

**DMS6200** ↵ ↵ *indicates the return key.*

The title is then displayed. To return to DOS at this point, press ^C (CTRL + C).

***Initial screen***

```
       *** E0C6200 Development tool Management System. --- Ver 1.0 ***

     EEEEEEEEEE   PPPPPPPP         SSSSSSS        OOOOOOOO      NNN      NNN
     EEEEEEEEEE   PPPPPPPPPP      SSS   SSSS     OOO    OOO     NNNN     NNN
     EEE          PPP     PPP    SSS     SSS    OOO      OOO    NNNNN    NNN
     EEE          PPP     PPP     SSS           OOO      OOO    NNNNNN   NNN
     EEEEEEEEEE   PPPPPPPPPP       SSSSSS       OOO      OOO    NNN NNN NNN
     EEEEEEEEEE   PPPPPPPP            SSSS      OOO      OOO    NNN  NNNNNN
     EEE          PPP                  SSS     OOO      OOO    NNN   NNNNN
     EEE          PPP            SSS     SSS    OOO      OOO    NNN    NNNN
     EEEEEEEEEE   PPP            SSSS   SSS     OOO    OOO     NNN     NNN
     EEEEEEEEEE   PPP              SSSSSSS        OOOOOOOO      NNN      NN

                    (C) Copyright 1991 SEIKO EPSON CORP.


                                 STRIKE ANY KEY.
```

(2) Press any key and the following menu screen will be displayed. A list of all executable files having "EXE", "COM" and "BAT" extensions will appear on this menu screen; if any execution file other than S5U1C62xxxD were copied to the current drive for execution, it will differ from the displays shown below.

***Menu screen***

```
           DMS6200 Version 1.0     Copyright(C) SEIKO EPSON CORP. 1991.

     1) ASM62XX .EXE
     2) FOG62XX .EXE
     3) ICS62XXB.BAT
     4) ICS62XXW.EXE
     5) MDC62XX .EXE
     6) MLA628X .EXE
     7) SOG62XX .EXE

     Input Number ? [   ]
```

To return to DOS at this point, press the "ESC" key.

(3) Input the number of the development support tool you wish to start and then press the "RETURN" key. Next, the screen for entering the source file will be displayed.

```
    Input Number ? [1  ]
```

(4) The following sample screen is the screen which will be displayed when ASM62XX is selected. Input the number of the source file.
Pressing the "ESC" key here will return the previous screen.
When the source file is selected by number, the edit line enclosed in [ ] will appear; enter the option parameter if necessary. The "BS" key is valid on the edit line. Press the "RETURN" key when input is completed.

***Source file selection screen***

```
            DMS6200 Version 1.0     Copyright(C) SEIKO EPSON CORP. 1991.

        1)   C2XXYYY .DAT
        2)   C28XYYY .MDT
        3)   C28XYYY .MPR
        4)   C2XXYYY .PRN
        5)   C2XXYYY .SEG
        6)   C28XYYYA.DOC
        7)   C28XYYYA.HEX
        8)   C2XXYYYF.DOC
        9)   C2XXYYYF.HEX
       10)   C2XXYYYH.HEX
       11)   C2XXYYYL.HEX
       12)   C2XXYYYS.DOC
       13)   C2XXYYYS.HEX
       14)   C62XXYYY.PA0

     Input Number ? [1  ]

       Edit > [ASM62XX C2XXYYY                                          ]
```

The above operation will activate the ASM62XX. (The MLA628X will also activate with the same operation.)
When the source file is in another file or directory it will not be displayed in the menu. In such cases you skip the number input using the return key and input the drive / directory and source file name in the edit line.
When starting, press the "RETURN" key twice particularly for the support tools which do not require source files (except the ASM62XX and the MLA628X).
Refer to the support manuals regarding operations after starting.

(5) When execution of the development support tool is completed, the following message will appear:

```
    Input Any Key ...
```

Press any key and the first menu screen will be returned.

# III

## CROSS ASSEMBLER

# ASM62XX

This part mainly explains how to operate the Cross Assembler ASM62XX for the S1C62 Family, and how to generate source files.

# CROSS ASSEMBLER ASM62XX

## Contents

# 1 DIFFERENCES DEPENDING ON THE MODEL

Since the memory capacity will vary with each model of the S1C62 Family you must pay attention to the following points when preparing a program.
The limiting items for each model are indicated in the "S5U1C62xxxD Manual".

## ■ ROM area

The ROM capacity will vary depending on the model.
The number of banks (16 pages / bank) and the number of pages (256 steps / page) are determined by this ROM capacity and the memory setting pseudo-instruction and the "PSET" instruction is limited to within its range.

| | ***Valid specification range*** |
|---|---|
| ORG pseudo-instruction: | 0000H–ROM final step |
| PAGE pseudo-instruction: | 00H–number of page - 1 |
| BANK pseudo-instruction: | 1 bank configuration model → 0H only |
| | 2 bank configuration model → 0H and 1H |
| PSET instruction: | 00H–number of page - 1 |

When a specification beyond this valid specification range is made to the ASM62XX an error is produced.

## ■ RAM area

The RAM capacity varies depending on the model.
The number of pages (256 words / page) is determined according to the RAM capacity. Also, the undefined area includes from the 0 address to the final RAM address.
When an undefined address is set in the index register, memory access to it becomes invalid, but be careful that no errors develop in the ASM62XX.

## ■ Undefined code

In the S1C62 Family, the instruction set is not different from model to model. However, you may not be able to use instructions such as the SLP instruction and those that access the page section (XP and YP) of the index register depending on the RAM content.

# 2 ASM62XX OUTLINE

## 2.1 Outline

The ASM62XX cross assembler (the ASM62XX in this manual) is an assembler program for generating the machine code used by the S1C62XXX 4-bit, single-chip microcomputers. It can be used under PC-DOS.

The Cross Assembler ASM62XX will assemble the program source files which have been input by the user's editor and will generate an object file in Intel-Hex format and assembly list file.
In this assembler, program modularization has been made possible through macro definition functions and programming independent of the ROM page structure has been made possible through the auto page set function. In addition, consideration has also been given to precise error checks for program capacity (ROM capacity) overflows, undefined codes and the like, and for debugging of such things as label tables for assembly list files and cross reference table supplements.

The program name of the assembler is ASM62XX.EXE.

Figure 2.1.1 shows the ASM62XX execution flow.

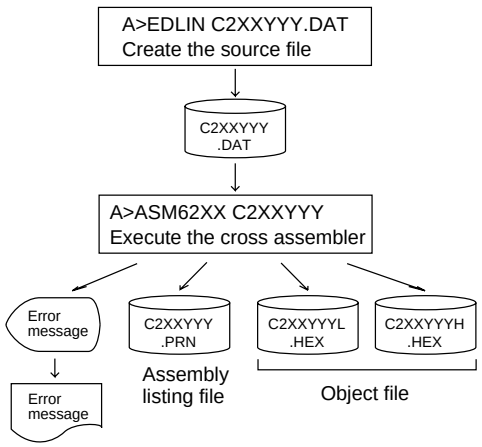



*Fig. 2.1.1 ASM62XX execution flow*

## 2.2 ASM62XX Input/Output Files

ASM62XX reads a source file, assembles it, and outputs object files and an assembly listing file.

### ■ Source file (C2XXYYY.DAT)

This is a source program file produced using an editor such as EDLIN. The file name format is C2XXYYY, and the file name must not exceed seven characters in length. Character string YYY should be determined by referencing the device name specified by Seiko Epson. The file extension must be added ".DAT".

### ■ Object file (C2XXYYYH.HEX, C2XXYYYL.HEX)

This is an assembled program file in Intel hex format. Because the machine code of the S1C62XXX is 12-bit, the high-order bytes (bits 9 to 12 suffixed by high-order bits 0000B) are output to file C2XXYYYH.HEX, and the low-order bytes (bits 8 to 1) are output to file C2XXYYYL.HEX.

### ■ Assembly listing file (C2XXYYY.PRN)

This is a program listing file generated by adding an operation codes and error messages (if any errors have occurred) to respective source program statements. A cross-reference table is generated at the end of the file, depending on the label table and options. The file name is C2XXYYY.PRN.

See the Appendix for the contents of each file.

# 3 ASM62XX OPERATION PROCEDURE

This section explains how to operate ASM62XX.

## 3.1 Starting ASM62XX

When starting ASM62XX, enter the following at DOS command level (when a prompt such as A> is being displayed):

**ASM62XX _ [drive-name:] source-file-name [.shp] _ [-N] ↵**

*_ indicates a blank.*
*A parameter enclosed by [ ] can be omitted.*
*↵ indicates the return key.*

When starting ASM62XX through the DMS6200, selects the "ASM62XX.EXE" and source file in the menu screen, and input options necessary.

### ■ Drive name

If the source file is not on the same disk as ASM62XX.EXE, specify a disk drive mounted the floppy disk storing the source file before input the source file name. If the source file is on the same disk as ASM62XX.EXE, it does not need to specify the disk drive.

### ■ Source file name

This is the name of the source file to be entered for ASM62XX. The source file name must not exceed seven characters in length. File extension .DAT must not be entered.

### ■ .shp

Characters s, h, and p are options for specifying the file I/O drives, and can be omitted.

- s: Specifies the drive from which the source file is to be input. A character from A to P can be specified. If @ is specified, the source file in the current drive (directory) is input. Even if a drive name is prefixed to the source file name, this option is effective.
- h: Specifies the drive to which the object file (HEX) is to be output. A character from A to P can be specified. If @ is specified, the object file is output to the current drive (directory). If Z is specified, only assembly is executed; the object file is not generated.
- p: Specifies the drive to which the assembly listing file is to be output. A character from A to P can be specified. If @ is specified, the object file is output to the current drive (directory). If X is specified, a listing containing error messages is output to the console. If Z is specified, the assembly listing file is not generated.

Characters s, h, p must all be specified; only one or two of them is not sufficient.

### ■ -N option

The code (FFH) in the undefined area of program memory is not created.

*Note The program data to be provided does not use the "-N" option. The FFH data should be inserted into the undefined program area.*

Example 1: Basic assembly example

```
A>ASM62XX C2XXYYY↵
```

The source file "C2XXYYY.DAT" is input from drive A, and the object files "C2XXYYYH.HEX" and "C2XXYYYL.HEX" and the assembly listing file "C2XXYYY.PRN" are output to drive A.

```
A>ASM62XX B:C2XXYYY↵
```

The source file "C2XXYYY.DAT" is input from drive B, and the object files "C2XXYYYH.HEX" and "C2XXYYYL.HEX" and the assembly listing file "C2XXYYY.PRN" are output to drive B.

```
A>ASM62XX C2XXYYY.BBZ↵
```

The source file "C2XXYYY.DAT" is input from drive B, and the object files "C2XXYYYH.HEX" and "C2XXYYYL.HEX" are output to drive B. The assembly listing file is not generated.

Example 2: -N option use

```
A>ASM62XX C2XXYYY -N↵
```

No undefined program area is generated in the created object files (C2XXYYYH.HEX, C2XXYYYL.HEX).
Refer to APPENDIX, "ASM62XX EXECUTION EXAMPLE".

```
A>ASM62XX C2XXYYY↵
```

In this case, FFH data is inserted into the undefined program area of the object files.

When ASM62XX is started, the following start-up message is displayed.

Example: When assembling C2XX0A0.DAT

```
A>ASM62XX C2XX0A0
          *** E0C62XX CROSS ASSEMBLER. --- Ver 2.00 ***

EEEEEEEEEE   PPPPPPPP        SSSSSSS       OOOOOOOO     NNN     NNN
EEEEEEEEEE   PPPPPPPPPP     SSS   SSSS    OOO    OOO    NNNN    NNN
EEE          PPP     PPP   SSS     SSS   OOO      OOO   NNNNN   NNN
EEE          PPP     PPP    SSS          OOO      OOO   NNNNNN  NNN
EEEEEEEEEE   PPPPPPPPPP      SSSSSS      OOO      OOO   NNN NNN NNN
EEEEEEEEEE   PPPPPPPP           SSSS     OOO      OOO   NNN  NNNNNN
EEE          PPP                SSS     OOO      OOO   NNN   NNNNN
EEE          PPP           SSS     SSS   OOO      OOO   NNN    NNNN
EEEEEEEEEE   PPP           SSSS   SSS     OOO    OOO    NNN     NNN
EEEEEEEEEE   PPP             SSSSSSS       OOOOOOOO     NNN      NN

              (C) COPYRIGHT 1991 SEIKO EPSON CORP.

           SOURCE FILE NAME IS " C2XXYYY.DAT "

           THIS SOFTWARE MAKES NEXT FILES.

              C2XXYYYH.HEX  ...  HIGH BYTE OBJECT FILE.
              C2XXYYYL.HEX  ...  LOW BYTE OBJECT FILE.
              C2XXYYY .PRN  ...  ASSEMBLY LIST FILE.
```

## 3.2 Selecting Auto-Page-Set Function

After the start-up message, the following message is displayed, prompting the user to select the auto-page-set function.

```
DO YOU NEED AUTO PAGE SET?(Y/N)
```

Press the "Y" key if selecting the auto-page-set function, or the "N" key if not selecting it. At this stage, the user can also return to the DOS command level by entering "CTRL" + "C" key.

### ■ Auto-page-set function

When the program branches to another page through a branch instruction such as JP, the branch-destination page must be set using the PSET instruction before executing the branch instruction. The auto-page-set function automatically inserts this PSET instruction. It checks whether the branch instruction page is the same as the branch-destination one. If the page is different, the function inserts the "PSET" instruction. If the page is the same, the function performs no operation.
Therefore, do not select the auto-page-set function if "PSET" instructions have been correctly included in the source file.

*Note When auto-page-set is selected, there are restricted items related to source programming. See "4.3.1 Label".*

## 3.3 Generating a Cross-Reference Table

After the auto-page-set function has been selected, the following message is output, prompting the user to select cross-reference table generation.

```
DO YOU NEED CROSS REFERENCE TABLE?(Y/N)
```

Press the "Y" key if generating the cross-reference table, or the "N" key if not generating it. At this stage, the user can also return to DOS command level by entering "CTRL" + "C" key.

*Note If the assembly listing file output destination (p option) is specified as Z (listing not generated) at the start of ASM62XX, the above message is not output and the cross-reference table is not generated.*

### ■ Cross-reference table

The cross-reference table lists the symbols and their locations in the source file, and is output at the end of the assembly listing file in the following format:

```
 CROSS REFERENCE TABLE   PAGE X-  1
LABEL1  4#       29        36        ....
LABEL2  15#      40
   :     :        :
```

Symbol

Number of the program statement
(# indicates the number of the statement at which the symbol was defined)

This table should be referenced during debugging. An error such as duplicate definition of a symbol can be easily detected.

# 4 SOURCE FILE FORMAT

The source file contains the source program consisting of S1C62XXX instructions (mnemonics) and pseudo-instructions, and is produced using an editor such as EDLIN.

Refer to the "S1C6200/6200A Core CPU Manual" and the "S1C6xxx Technical Manual (Software)" for instruction sets.

## 4.1 Source File Name

A desired file name not exceeding seven characters in length can be assigned to each source file. The format must be as follows:

**C2XXYYY.DAT**

"YYY" of the "C2XXYYY.DAT" is an alphanumeric character string of up to three characters, and should be determined by referencing the device name specified by Seiko Epson. The file extension must be ".DAT".

## 4.2 Statements

Each source program statement must be written using the following format.

Basic format: **<Index>[:] <Instruction> <Expression> <; comment>**

Example:

```
ON          EQU         1
            ORG         100H
START:      JP          INIT        ;To init.
```

| Label field | Mnemonic field | Operand field | Comment field |
|---|---|---|---|

A statement consists of four fields: label, mnemonic, operand, and comment. Up to 132 characters can be used for one statement. Fields must be delimited by one or more blanks or tabs.
The label and comment fields are optional. Blank lines consisting only of a carriage return (CR) code are also allowed.
Although each statement and field (excluding the label field) can begin at any desired column. The program becomes easier to understand if the heads of corresponding fields are aligned.

### 4.2.1 Label field

The label field can contain a label for referencing the memory address, a symbol that defines a constant, or a macro name. This field can be omitted if the statement name is not required. The label field must begin at column 1 and satisfy the following conditions.

- The length must not exceed 14 characters.
- The same name as a mnemonic or register name must not be used.
- The following alphanumeric characters can be used, but the first character must not be a digit:
  A to Z, a to z, 0 to 9, _ , ?
- The uppercase and lowercase forms of a letter are equivalent.
- ??nnnn (n is a digit) cannot be used as a name.

A colon ":" can be used as a delimiter between a label field and the mnemonic field. If a colon is used, neither blanks nor tabs need to be written subsequently.
Statements consisting of only a label field are also allowed.

### *4.2.2 Mnemonic field*

The mnemonic field is used for an instruction mnemonic or a pseudo-instruction.

### *4.2.3 Operand field*

The operand field is used for the operands of the instruction. The form of each operand and the number of operands depend on the kind of instruction. The form of expressions specifying values must be one of the following:

- A numeric constant, a character constant, or a symbol that defines a constant
- A label indicating a memory address
- An operational expression for obtaining the specified value

If the operand consists of two or more expressions, the expressions must be separated by commas ",".

### *4.2.4 Comment field*

The comment field is used for comment data such as program headers and descriptions of processing. The contents of this field do not affect assembly or the object files generated by assembly.

The part of the statement from a semicolon ";" to the CR code at the end of the statement is considered to be the comment field. Statements consisting of only a comment field are also allowed. When a comment spans multiple lines, a semicolon must be written at the beginning of each line.

## *4.3 Index*

ASM62XX allows values to be referenced by their indexes.
Refer to Section 4.2.1, "Label field", for the restrictions on index descriptions.

### *4.3.1 Label*

A label is an index for referencing a location in the program, and can be used as an operand that specifies a memory address as immediate data in an instruction. For example, a label can be used as the operand of an instruction such as JP by writing the label in the branch-destination statement.
The name written in the label field of an EQU or SET instruction is considered to be a symbol, not a label.

Example:

```
                :
                JP   NZ,LABEL1
                :
                :
LABEL1:         LD   A,0
```

A label can be assigned to any statement, but the label assigned to the following pseudo-instructions is ignored:

ORG, BANK, PAGE, SECTION, END, LABEL, ENDM

*Note* *When selecting the auto-page-set function (see Section 3.2), a statement consisting of only a label must be written immediately before the JP or CALL instructions.*

Example:

```
        PGSET:
                JP   LABEL
```

### *4.3.2 Symbol*

A symbol is an index that indicates a numeric or character constant, and must be defined before its value is referenced (usually at the beginning of the program). The defined symbol can be used as the operand that specifies immediate data in an instruction.

Example:

```
ON   EQU  1            (See Section 4.5 for EQU.)
OFF  EQU  0
     :
     LD   A,ON      ; = LD A,1
     :
     LD   A,OFF     ; = LD A,0
     :
```

## *4.4 Constant and Operational Expression*

This section explains the immediate data description formats.

### *4.4.1 Numeric constant*

A numeric constant is processed as a 13-bit value by ASM62XX. If a numeric constant greater than 13 bits is written, bit 13 and subsequent high-order bits are ignored.
Note that the number of actual significant bits depends on the operand of each instruction. If the value of a constant is greater than the value that can be accommodated by the actual number of significant digits, an error occurs.

Example:

```
ABC  EQU  0FFFFH    →   ABC is defined as 1FFFH.
     LD   A,65535   →   An error occurs because it exceeds the significant digit
                        count (4 bits).
```

The default radix is decimal. The radix description formats are as follows:

*Binary numeral:* A numeral suffixed with B, such as 1010B (=10) or 01100100B (=100).

*Octal numeral:* A numeral suffixed with O or Q, such as 012O (=10) or 144Q (=100).

*Decimal numeral:* A numeral alone or a numeral suffixed with D, such as 10 or 100D (=100).

*Hexadecimal numeral:* A numeral suffixed with H, such as 0AH (=10) or 64H (=100).
If the value begins with a letter from A to F, it must be prefixed with 0 to distinguish it from a name.

### *4.4.2 Character constant*

A character constant is one or two ASCII characters enclosed by apostrophes (' '). A single ASCII character is processed as eight-bit data. If two or more ASCII characters are written, only the last two characters are significant as 13-bit data.

Examples:

`'A'` (=41H), `'BC'` (=0243H), `'PQ'` (=1051H), `'DEFGH'` → `'GH'` (=0748H; DEF is ignored.)

The apostrophe itself cannot be processed as a character constant, so it must be written as a numeric constant, such as 27H or 39.

### *4.4.3 Operator*

When specifying a value for an item such as an operand, an operational expression can be written instead of a constant, and its result can be used as the value.
Labels and symbols as well as constants can be used as terms in expressions. These values are processed as 13-bit data (bit 14 and subsequent high-order bits are ignored); the operation result also consists of 13 bits. If the result exceeds the number of significant digits of the instruction operand, an error occurs.
There are three types of operator—arithmetic, logical, and relational—as listed below (a and b represent terms, and _ represents one or more blanks).

#### ■ Arithmetic operators

There are 11 arithmetic operators including the ones for addition, subtraction, multiplication, division, bit shifting, and bit separation.

| | |
|---|---|
| +a | Monadic positive (indicates the subsequent value is positive) |
| -a | Monadic negative (indicates the subsequent value is negative) |
| a+b | Addition (unsigned) |
| a-b | Subtraction (unsigned) |
| a*b | Multiplication (unsigned) |
| a/b | Division (unsigned) |
| a_MOD_b | Remainder of a / b |
| a_SHL_b | Shifts a b bits to the left. ←[b7<<<<<<b1]←0<br>Example: `00000011B SHL 2 → 00001100B` |
| a_SHR_b | Shifts a b bits to the right. 0→[b7>>>>>>b0]→<br>Example: `11000011B SHR 2 → 00110000B` |
| HIGH_a | Separates the high-order eight bits from a (13 bits).<br>Example: `HIGH 1234H → 12H` |
| LOW_a | Separates the low-order eight bits from a (13 bits).<br>Example: `LOW 1234H → 34H` |

#### ■ Logical operators

There are four logical operators as listed below. The logical operator returns the result of logical operation on the specified terms.

| | |
|---|---|
| a_AND_b | Logical product<br>Example: `00001111B AND 00000011B → 00000011B` |
| a_OR_b | Logical sum<br>Example: `00001111B OR 11110000B → 11111111B` |
| a_XOR_b | Exclusive logical sum<br>Example: `00001111B XOR 00000011B → 00001100B` |
| NOT_a | Logical negation<br>Example: `NOT 00001111B → 11110000B` |

## ■ Relational operators

A logical operator compares two terms; if the relationship between the terms is as the operator specifies, 1FFFH (true) is returned; if not, 0 (false) is returned.

| | |
|---|---|
| a_EQ_b | True when a is equal to b |
| a_NE_b | True when a is not equal to b |
| a_LT_b | True when a is less than b |
| a_LE_b | True when a is less than or equal to b |
| a_GT_b | True when a is greater than b |
| a_GE_b | True when a is greater than or equal to b |

Be sure to insert one or more blanks for symbol "_" between terms. All operators must be entered in uppercase letters.

An expression can contain one or more operators and pairs of parenthesis. In this case, operators are basically evaluated from left to right. However, an operation stipulated by an operator with higher priority or by parentheses is executed earlier. Every left parenthesis must have a corresponding right parenthesis.

The following table shows the priority of operators.

| Operator | Priority |
|---|---|
| ) | Low |
| OR, XOR | : |
| AND | |
| EQ, NE, LT, LE, GT, GE | |
| + (addition), - (subtraction) | |
| *, /, MOD, SHL, SHR | |
| ( | |
| HIGH, LOW, NOT | : |
| - (monadic negative), + (monadic positive) | High |

Examples: Operational expressions (ABC = 1, BCD = 3)

```
LD   A,BCD*(ABC+1)  ;A-register <- 6
LD   A,ABC LT BCD   ;A-register <- 0FH (1111B)
OR   B,ABC SHL BCD  ;Set bit 3 in B-register
                    ;(=OR B,1000B)
AND B,ABC SHL BCD XOR 0FH
                    ;Reset bit 3 in B-register
                    ;(=AND B,0111B)
```

### *4.4.4 Location counter*

The start address of each instruction code is set in the location counter when a statement is assembled. A label or $ can be used when referencing the location counter value in a program.

## ■ Location counter

The location counter consists of 13 bits: one bit for the bank field, four bits for the page counter field, and eight bits for the step counter field.

| | Bank | Page counter | | | | Step counter | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bit | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Contents | Bank | Page address | | | | Step address | | | | | | | |
| | BNK | PCP | | | | PCS | | | | | | | |

Example:

```
                Location counter
              (BNK) (PCP) (PCS)
                0     1    02        JP   $+3
```

The location counter indicates the start address of the JP instruction, and the PCS value (02) is assigned to $. Consequently, the statement is assembled as "JP 5", and the program sequence jumps to the location three steps before (PCS=05) when it is executed.

## 4.5 Pseudo-Instructions

There are four types of pseudo-instruction: data definition, memory setting, assembler control, and macro. These pseudo-instructions as well as operational expressions can be used to govern assembly, and are not executed in the developed program.

In the subsequent explanations, the items enclosed by < > in the pseudo-instruction format must be written in the statement (do not write the < > characters themselves). Symbol _ represents one or more blanks or tabs. One or more symbols and constants or an operational expression can be used in <expression>. See Section 4.6 for macro functions.

### 4.5.1 Data definition pseudo-instructions

There are three data definition pseudo-instructions: EQU, SET, and DW. The EQU and SET pseudo-instructions each define a symbol, and the DW pseudo-instruction presets data in program memory.

#### ■ EQU (Equate)

| *<Symbol>_EQU_<Expression>* | *To define a symbol* |
|---|---|

The EQU pseudo-instruction defines <symbol> (written in the label field) as having the value of <expression> (written in the operand field).
If a value greater than 13 bits is specified in <expression>, bit 14 and subsequent high-order bits are ignored.
This definition must be made before the symbol is referenced in the program. A U-error occurs if an attempt is made to reference a symbol that has not been defined.
The same symbol cannot be defined more than once. A P-error occurs if an attempt is made to define a symbol that has already been defined.

Examples:

```
ZERO    EQU     30H
ONE     EQU     ZERO+1
ONE     EQU     31H         ← P-error because ONE has been defined more than twice
FOUR    EQU     TWO*2       ← U-error because TWO has not been defined
```

#### ■ SET

| *<Symbol>_SET_<Expression>* | *To define a symbol* |
|---|---|

Like EQU, the SET pseudo-instruction defines the value of <symbol> as being <expression>. The SET pseudo-instruction allows a symbol to be redefined.

Examples:

```
ZERO    EQU     30H
BIT     SET     1
          :
BIT     SET     2           ← Redefinition possible
          :
BIT     SET     BIT SHL 1   ← Previously-defined items can be referenced
```

### ■ DW (Define Word)

| *<Label>_DW_<Expression>* | *To preset data* |
|---|---|

The DW pseudo-instruction assigns the value of <expression> (the low-order 12 bits when the value is greater than 12 bits) to the current memory location, indicated by the location counter.

Examples:

```
        Location counter
(BNK) (PCP) (PCS)
  0     2     0A     TABLE   DW    141H    ; = RETD 'A'
  0     2     0B             DW    142H    ; = RETD 'B'
  0     2     0C             DW    143H    ; = RETD 'C'
                             :
```

<label> can be omitted.

## *4.5.2 Memory setting pseudo-instructions*

The program memory mounted at the S1C62XXX is divided into 256-step pages. Memory management (including the setting of the program location and page boundaries) during program generation must be controlled by the source program.
The memory setting pseudo-instructions are used to specify memory management. The assembler sets the location counter according to these pseudo-instructions.
If a memory area that has already been used is specified or a statement that exceeds the page is used without specifying that the statement is to exceed the page, the assembler displays an exclamation mark "!", indicating a warning, and ignores all subsequent statements until the next correct statement. This should be taken into account.
When using the auto-page-set function, the space for insertion of the "PSET" pseudo-instruction must be allocated in each page.

### ■ ORG (Origin)

| *ORG_<Expression>* | *To set the location counter* |
|---|---|

The ORG pseudo-instruction sets the location counter to the value of <expression>.
If the ORG pseudo-instruction is not written at the beginning of the program, the location counter is set to 0 (BNK=0, PCP=0, PCS=0) and assembly is started.
The ORG pseudo-instruction can be used at multiple locations in the program. However, it cannot be used to set the location to a value before the current location. If this is attempted, an exclamation mark "!", indicating a warning, is displayed, and all subsequent statements until the next correct statement are ignored.
A label can be written before the ORG statement, but it cannot be referenced because it is not cataloged in the label table. In this case, write the label in the statement following the ORG pseudo-instruction.

Example:

```
            ORG   0100H   ; BNK=0, PCP=1, PCS=00H
START        :
```

An R-error occurs if a value is specified exceeding the ROM capacity.

*Note The upper limit of program memory depends on the model. (Refer to the "S5U1C62xxxD Manual".)*

## ■ BANK

| *BANK_<Expression>* | *To set the bank (BNK)* |
|---|---|

The BANK pseudo-instruction sets the value of <expression> in the bank (BNK) field, and sets the page counter (PCP) and step counter (PCS) to 00H.
The BANK pseudo-instruction can be written at multiple locations in the program. However, it cannot be used to specify the current bank (excluding the specification in page 00, step 00) or a previous bank. If it is used to specify the current bank or a previous bank, an exclamation mark "!", indicating a warning, is displayed, and all subsequent statements until the next correct statement are ignored.
A label can be written before the BANK statement, but it cannot be referenced because it is not cataloged in the label table. In this case, write the label in the statement after the BANK pseudo-instruction.

## ■ PAGE

| *PAGE_<Expression>* | *To set the page counter (PCP)* |
|---|---|

The PAGE pseudo-instruction sets the value of <expression> in the page counter (PCP) and sets the step counter (PCS) to 00H.
The PAGE pseudo-instruction can be written at multiple locations in the program. However, it cannot be used to specify the current page (excluding the specification in step 00) or a previous page. If it is used to specify the current page or a previous page, an exclamation mark "!", indicating a warning, is displayed, and all subsequent statements until the next correct statement are ignored.
A label can be written before the PAGE statement, but it cannot be referenced because it is not cataloged in the label table. In this case, write the label in the statement after the PAGE pseudo-instruction.

Example:

```
        Location counter
(BNK)  (PCP)  (PCS)
  :      :      :              :     :
  0      0     1AH             LD    X,0
  0      0     1BH             LD    Y,0
  :      :      :              :     :
  0      0     F0H             JP    xxx

                                PAGE  2
  0      2     00H    SUB1:    LD    A,MX   ┐ Ineffective because a previous page
  0      2     01H             LD    B,MY   ┘ was specified
  :      :      :              :     :

                                PAGE  1
  !                   SUB2:    LD    A,MX   ┐
  !                            LD    B,MY   ┘ Effective
                               :     :

                                PAGE  3
  0      3     00H    SUB3:    LD    A,0
  0      3     01H             LD    B,1
  :      :      :              :     :
```

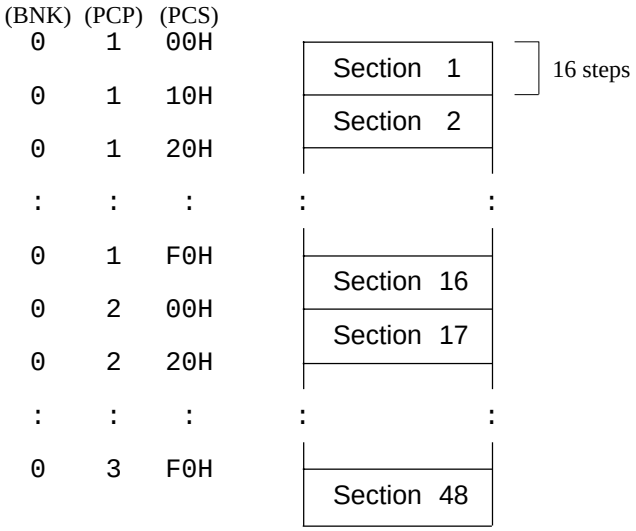
An R-error occurs if a value is specified that exceeds the last page.

*Note The last page depends on the model. (Refer to the "S5U1C62xxxD Manual".)*

## ■ SECTION

| *SECTION* | *To change the section* |
|---|---|

The SECTION pseudo-instruction sets the first address of the subsequent section in the location counter. Sections are 16-step areas starting from the beginning of the program memory.




A SECTION pseudo-instruction written in the last section of the page not only clears the step counter but also updates the page counter, so a new page need not be specified.

A label can be written before the SECTION pseudo-instruction, but it cannot be referenced because it is not cataloged in the label table. In this case, write the label in the statement following the SECTION pseudo-instruction.

Example:

```
          Location counter
(BNK) (PCP) (PCS)
  :     :     :              :       :
  0     1    09H             JPBA
  0     1    0AH             LD      X,0
  0     1    0BH             LD      Y,0
  0     1    0CH             LD      MX,4

                             SECTION
  0     1    10H    TABLE    LD      A,1
  0     1    11H             ADD     A,1
  :     :     :              :       :
  0     1    FAH             RET

                             SECTION
  0     2    00H             LOOP    SCF
  0     2    01H             ADD     A,MY
  :     :     :              :       :
```

### *4.5.3 Assembler control pseudo-instructions*

■ **END**

| *END* | *To terminate assembly* |
|---|---|

The END statement terminates assembly. All statements following the END statement are ignored. Be sure to write this statement at the end of the program. If it is missing, assembly may not terminate.
A label can be written before the END statement, but it cannot be referenced because it is not cataloged in the label table.

## *4.6 Macro-Functions*

When using the same statement block at multiple locations in a program, the statement block can be called using a name defined beforehand. A statement block that has been so defined is called a macro.
Unlike a subroutine, the statement block is expanded at all locations where it is called, so the programmer should consider the statement block size and frequency of use and determine whether a macro or a subroutine is more appropriate.

### *4.6.1 Macro-instructions*

ASM62XX provides the macro-instructions listed below so that branching between pages is possible without specifying the destination page using the PSET instruction.

Character string ps represents 13-bit immediate data that indicates the branch-destination address. A label can be used for it.

| Macro-instruction | Mnemonic after expansion | Code | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| JPM ps | PSET p | 1 | 1 | 1 | 0 | 0 | 1 | 0 | p4 | p3 | p2 | p1 | p0 |
| | JP s | 0 | 0 | 0 | 0 | s7 | s6 | s5 | s4 | s3 | s2 | s1 | s0 |
| JPM C,ps | PSET p | 1 | 1 | 1 | 0 | 0 | 1 | 0 | p4 | p3 | p2 | p1 | p0 |
| | JP C,s | 0 | 0 | 1 | 0 | s7 | s6 | s5 | s4 | s3 | s2 | s1 | s0 |
| JPM NC,ps | PSWT p | 1 | 1 | 1 | 0 | 0 | 1 | 0 | p4 | p3 | p2 | p1 | p0 |
| | JP NC,s | 0 | 0 | 1 | 1 | s7 | s6 | s5 | s4 | s3 | s2 | s1 | s0 |
| JPM Z,ps | PSET p | 1 | 1 | 1 | 0 | 0 | 1 | 0 | p4 | p3 | p2 | p1 | p0 |
| | JP Z,s | 0 | 1 | 1 | 0 | s7 | s6 | s5 | s4 | s3 | s2 | s1 | s0 |
| JPM NZ,ps | PSET p | 1 | 1 | 1 | 0 | 0 | 1 | 0 | p4 | p3 | p2 | p1 | p0 |
| | JP NZ,s | 0 | 1 | 1 | 1 | s7 | s6 | s5 | s4 | s3 | s2 | s1 | s0 |
| CALLM ps | PSET p | 1 | 1 | 1 | 0 | 0 | 1 | 0 | p4 | p3 | p2 | p1 | p0 |
| | CALL s | 0 | 1 | 0 | 0 | s7 | s6 | s5 | s4 | s3 | s2 | s1 | s0 |

Example:

*Source file*

```
                :
                JPM     LABEL2
                :
                PAGE    2
        LABEL2  LD      A,0
                :
```

*Assembly list file after expansion*

```
                :
                JPM     LABEL2
      +          PSET   LABEL2
      +          JP     LABEL2
                :
                PAGE    2
        LABEL2  LD      A,0
                :
```

### *4.6.2 Macro-definitions*

The macro-definition should be done by using the MACRO and the ENDM instructions (pseudo-instruction).

#### ■ MACRO ~ ENDM

```
<Macro-name>_MACRO_[<Dummy-argument>, ...]
        Statement
           :
        ENDM
```

The statement block enclosed by a MACRO pseudo-instruction and an ENDM pseudo-instruction is defined as a macro. Any name can be assigned to the macro as long as it conforms to the rules regarding the characters, length, and label field.

A macro can have an argument passed to it when it is called. In this case, any symbol can be used as a dummy argument in the macro definition where the actual argument is to be substituted and the same symbol must be written after the MACRO pseudo-instruction. Multiple dummy arguments must be separated by commas (,).

Be sure to write the ENDM statement at the end of a macro-definition.

Example: This macro loads data from the memory location specified by ADDR into the A or B register specified by REG. Sample call: LDM A,10H

```
LDM     MACRO   REG,ADDR
        LD      X,ADDR
        LD      REG,MX
        ENDM
```

These dummy arguments are replaced by actual arguments when the macro is expanded.

#### ■ LOCAL

If a macro having a label is expanded at multiple locations, the label duplicates, causing an error. The LOCAL pseudo-instruction prevents this error occurring.

```
LOCAL_<Label-name>[,<Label-name>...]
```

The label specified by the LOCAL pseudo-instruction is replaced by "??nnnn" when the macro is expanded. Field nnnn is a four-digit decimal field, to which values 0001 to 9999 are assigned sequentially.
The LOCAL pseudo-instruction must be written at the beginning of the macro. The LOCAL pseudo-instruction is ignored if another instruction precedes it.

Example:

```
WAIT    MACRO   CNT
        LOCAL   LOOP
        LD      A,CNT
LOOP    SBC     A,1         ← Replaces LOOP with ??nnnn at expansion.
        JP      NZ,LOOP
        ENDM
```

### *4.6.3 Macro-calls*

The defined macro-name can be called from any location in the program by using the following format:

| |
|---|
| ***[<Label>]_<Macro-name>_ [<Actual-argument>, ...]*** |

The MACRO can be called by using the macro-name.
When arguments are required, write actual arguments corresponding to the dummy arguments used in the macro-definition. Multiple actual arguments must be separated by commas (,).
Actual and dummy arguments correspond sequentially from left to right. If the number of actual arguments is greater than the number of dummy arguments, the excess actual arguments are ignored. If the number of actual arguments is less than the number of dummy arguments, the excess dummy arguments are replaced by nulls (00H).
Any label can be written before the macro-name.

Example:

*Source file*

```
                ORG     0200H

        CTAS    EQU     00H
        CTAE    EQU     02H
        CAFSET  EQU     0101B
        CAFRST  EQU     0000B
        CTBS    EQU     10H
        CTBE    EQU     08H
        CBFSET  EQU     0001B
        CBFRST  EQU     0100B

        COUNT   MACRO   FSET,FRST,CTS,CTE
                LOCAL   LOOP1
                SET     F,FSET
                RST     F,FRST
                LD      A,0
                LD      X,CTS
        LOOP1   ACPX    MX,A
                CP      XL,CTE
                JP      NZ,LOOP1
                ENDM

        COUNTA  COUNT   CAFSET,CAFRST,CTAS,CTAE
                RET

        COUNTB  COUNT   CBFSET,CBFRST,CTBS,CTBE
                RET

                END
```

The assembly listing file after assembly is shown on the next page.

*Assembly listing file*

```
LISTING OF ASM62XX     C2XX0A1.PRN  ........ PAGE   1
  LINE BANK PCP PCS    OBJ          SOURCE STATEMENT
     1                                    ORG     0200H
     2
     3                 0000=      CTAS    EQU     00H
     4                 0002=      CTAE    EQU     02H
     5                 0005=      CAFSET  EQU     0101B
     6                 0000=      CAFRST  EQU     0000B
     7                 0010=      CTBS    EQU     10H
     8                 0008=      CTBE    EQU     08H
     9                 0001=      CBFSET  EQU     0001B
    10                 0004=      CBFRST  EQU     0100B
    11
    12                            COUNT   MACRO   FSET,FRST,CTS,CTE
    13                                    LOCAL   LOOP1
    14                                    SET     F,FSET
    15                                    RST     F,FRST
    16                                    LD      A,0
    17                                    LD      X,CTS
    18                            LOOP1   ACPX    MX,A
    19                                    CP      XL,CTE
    20                                    JP      NZ,LOOP1
    21                                    ENDM
    22
    23                            COUNTA  COUNT   CAFSET,CAFRST,CTAS,CTAE
    24    0   2  00    F45     +         SET     F,CAFSET
    25    0   2  01    F50     +         RST     F,CAFRST
    26    0   2  02    E00     +         LD      A,0
    27    0   2  03    B00     +         LD      X,CTAS
    28    0   2  04    F28     + ??0001  ACPX    MX,A
    29    0   2  05    A52     +         CP      XL,CTAE
    30    0   2  06    704     +         JP      NZ,??0001
    31    0   2  07    FDF               RET
    32
    33                            COUNTB  COUNT   CBFSET,CBFRST,CTBS,CTBE
    34    0   2  08    F41     +         SET     F,CBFSET
    35    0   2  09    F54     +         RST     F,CBFRST
    36    0   2  0A    E00     +         LD      A,0
    37    0   2  0B    B10     +         LD      X,CTBS
    38    0   2  0C    F28     + ??0002  ACPX    MX,A
    39    0   2  0D    A58     +         CP      XL,CTBE
    40    0   2  0E    70C     +         JP      NZ,??0002
    41    0   2  0F    FDF               RET
    42
    43                                    END
```

# 5 ERROR MESSAGES

If an error occurs during assembly, ASM62XX outputs the appropriate error symbol or error message listed below to the console and assembly listing file.

Only a single error symbol is output at the beginning (column 1) of the statement that caused the error. (If two or more errors occurred, only the error with highest priority is output.)

The following error symbols are listed in order of priority, starting with the one with the highest priority.

**S** (Syntax Error) ..... An unrecoverable syntax error was encountered.

**U** (Undefined Error) ..... The label or symbol of the operand has not been defined.

**M** (Missing Label) ..... The label field has been omitted.

**O** (Operand Error) ..... A syntax error was encountered in the operand, or the operand could not be evaluated.

**P** (Phase Error) ..... The same label or symbol was defined more than once.

**R** (Range Error) .....
- The location counter value exceeded the upper limit of the program memory, or a location exceeding the upper limit was specified.
- A value greater than that which the number of significant digits of the operand will accommodate was specified.

**!** (Warning) .....
- Memory areas overlapped because of a "PAGE" or "ORG" pseudo-instruction or both.
- A statement exceeded a page boundary although its location was not specified.

**FILE NAME ERROR** ..... The source file name was longer than 8 characters.

**FILE NOT PRESENT** ..... The specified source file was not found.

**DIRECTORY FULL** ..... No space was left in the directory of the specified disk.

**FATAL DISK WRITE ERROR** ..... The file could not be written to the disk.

**LABEL TABLE OVERFLOW** ..... The number of defined labels and symbols exceeded the label table capacity (4000).

**CROSS REFERENCE TABLE OVERFLOW**
..... The label / symbol reference count exceeded the cross- reference table capacity (only when the cross-reference table is generated).

# *APPENDIX ASM62XX EXECUTION EXAMPLE*

## *1) Source file (C2XX0A0.DAT)*

```
A>TYPE C2XX0A0.DAT
;
;*******<< SAMPLE PROGRAM :E0C62XX >>*******
;
ABC     EQU     0F0H
TEN     EQU     10
;
START   LD      A,0
LD      X,8
LD      Y,3
LDPX    A,MX
;
ORG     0E0H
;
NEXT    ADD     B,TEN
LD      MX,XH
AND     A,101B
FAN     MY,A
RCF
SCPX    MX,B
JP      C,NEXT
;
;-------<<          ERROR          >>-------
        EQU     0CH-2
ERROR   EQU     4
ERROR   LD      A,3
        SBD     MX,A
        INC     Z
        JP      UNDEF
        ORG     11100000B
        NOP5
        SECTION
        ORG     ABC+0FH
        NOP7
        NOP7
        END
```

## *2) Running the assembler (display on the console)*

```
A>ASM62XX C2XX0A0
          *** E0C62XX CROSS ASSEMBLER. --- VERSION 2.00 ***

    EEEEEEEEEE   PPPPPPPP        SSSSSSS       OOOOOOOO     NNN     NNN
    EEEEEEEEEE   PPPPPPPPPP     SSS   SSSS    OOO    OOO    NNNN    NNN
    EEE          PPP     PPP   SSS     SSS   OOO      OOO   NNNNN   NNN
    EEE          PPP     PPP    SSS          OOO      OOO   NNNNNN  NNN
    EEEEEEEEEE   PPPPPPPPPP      SSSSSS      OOO      OOO   NNN NNN NNN
    EEEEEEEEEE   PPPPPPPP           SSSS     OOO      OOO   NNN  NNNNNN
    EEE          PPP                SSS     OOO      OOO   NNN   NNNNN
    EEE          PPP            SSS     SSS   OOO      OOO   NNN    NNNN
    EEEEEEEEEE   PPP            SSSS   SSS     OOO    OOO    NNN     NNN
    EEEEEEEEEE   PPP              SSSSSSS       OOOOOOOO     NNN      NN

           (C) COPYRIGHT 1991  SEIKO EPSON CORP.

          SOURCE FILE NAME IS " C2XXYYY.DAT "

          THIS SOFTWARE MAKES NEXT FILES.

             C2XXYYYH.HEX  ...  HIGH BYTE OBJECT FILE.
             C2XXYYYL.HEX  ...  LOW BYTE OBJECT FILE.
             C2XXYYY .PRN  ...  ASSEMBLY LIST FILE.


          DO YOU NEED AUTO PAGE SET?(Y/N) N
          DO YOU NEED CROSS REFERENCE TABLE?(Y/N) Y
          M   23               000A=             EQU       0CH-2
          P   24               0004=      ERROR  EQU       4
          P   25    0   0  E7    E03       ERROR  LD        A,3
          S   26    0   0  E8    FFF              SBD       MX,A
          O   27    0   0  E9    FFF              INC       Z
          U   28    0   0  EA    000              JP        UNDEF
          !   30                                  NOP5
          R   34    0   1  00                     NOP7

          8 ERROR OR WARNING(S) DETECTED
          USED : 6/2000  SYMBOLS
A>
```

## *3) Assembly listing file (C2XX0A0.PRN)*

```
A>TYPE C2XX0A0.PRN
LISTING OF ASM62XX     C2XX0A0.PRN  ........  PAGE   1
  LINE BANK PCP PCS    OBJ          SOURCE STATEMENT
     1                              ;
     2                              ;*******<< SAMPLE PROGRAM :E0C62XX >>*******
     3                              ;
     4                 00F0=        ABC     EQU     0F0H
     5                 000A=        TEN     EQU     10
     6                              ;
     7    0   0  00     E00         START   LD      A,0
     8    0   0  01     B08                 LD      X,8
     9    0   0  02     803                 LD      Y,3
    10    0   0  03     EE2                 LDPX    A,MX
    11                              ;
    12                                      ORG     0E0H
    13                              ;
    14    0   0  E0     C1A         NEXT    ADD     B,TEN
    15    0   0  E1     EA6                 LD      MX,XH
    16    0   0  E2     C85                 AND     A,101B
    17    0   0  E3     F1C                 FAN     MY,A
    18    0   0  E4     F5E                 RCF
    19    0   0  E5     F39                 SCPX    MX,B
    20    0   0  E6     2E0                 JP      C,NEXT
    21                              ;
    22                              ;-------<<          ERROR          >>-------
M   23                 000A=                EQU     0CH-2
P   24                 0004=        ERROR   EQU     4
P   25    0   0  E7     E03         ERROR   LD      A,3
S   26    0   0  E8     FFF                 SBD     MX,A
O   27    0   0  E9     FFF                 INC     Z
U   28    0   0  EA     000                 JP      UNDEF
    29                                      ORG     11100000B
!   30                                      NOP5
    31                                      SECTION
    32                                      ORG     ABC+0FH
    33    0   0  FF     FFF                 NOP7
R   34    0   1  00                         NOP7
    35                                      END

8 ERROR OR WARNING(S) DETECTED

  LABEL TABLE          PAGE L-  1
  ABC     =00F0       ERROR   =0004       NEXT    0-0-E0       START    0-0-00
  TEN     =000A     U UNDEF   0-0-00

 CROSS REFERENCE TABLE   PAGE X-  1
ABC    4#       32
ERROR  24#      25#
NEXT   14#      20
START  7#
TEN    5#       14
UNDEF  28
```

## *4) Object files (C2XX0A0H.HEX, C2XX0A0L.HEX)*

```
A>TYPE C2XX0A0L.HEX
 :10000000000803E2FFFFFFFFFFFFFFFFFFFFFFF0F
 :10001000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF0
 :10002000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFE0
 :10003000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFD0
 :10004000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFC0
 :10005000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFB0
 :10006000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFA0
 :10007000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF90
 :10008000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF80
 :10009000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF70
 :1000A000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF60
 :1000B000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF50
 :1000C000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF40
 :1000D000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF30
 :1000E0001AA6851C5E39E003FFFF00FFFFFFFFF3C
 :1000F000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF10
 :10010000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
 :10011000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFEF
 :10012000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFDF
 :10013000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFCF
 :10014000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFBF
 :10015000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFAF
 :10016000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF9F
 :10017000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF8F
 :10018000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF7F
 :10019000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF6F
 :1001A000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF5F
 :1001B000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF4F
 :1001C000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF3F
 :1001D000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF2F
 :1001E000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1F
 :1001F000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF0F
 :10020000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFE
 :10021000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFEE
 :10022000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFDE
 :10023000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFCE
 :10024000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFBE
 :10025000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFAE
 :10026000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF9E
 :10027000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF8E
 :10028000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF7E
 :10029000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF6E
 :1002A000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF5E
 :1002B000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF4E
 :1002C000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF3E
 :1002D000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF2E
 :1002E000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1E
 :1002F000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF0E
 :10030000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFD
 :10031000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFED
 :10032000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFDD
 :10033000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFCD
 :10034000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFBD
 :10035000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFAD
 :10036000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF9D
 :10037000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF8D
 :10038000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF7D
 :10039000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF6D
 :1003A000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF5D
 :1003B000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF4D
 :1003C000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF3D
 :1003D000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF2D
 :1003E000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1D
 :1003F000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF0D
 :00000001FF
```

```
A>TYPE C2XX0A0H.HEX
 :100000000E0B080EFFFFFFFFFFFFFFFFFFFFFFCD
 :10001000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF0
 :10002000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFE0
 :10003000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFD0
 :10004000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFC0
 :10005000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFB0
 :10006000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFA0
 :10007000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF90
 :10008000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF80
 :10009000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF70
 :1000A000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF60
 :1000B000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF50
 :1000C000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF40
 :1000D000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF30
 :1000E0000C0S1C0F0F0F020E0F0F00FFFFFFFFF94
 :1000F000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF00
 :10010000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
 :10011000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFEF
 :10012000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFDF
 :10013000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFCF
 :10014000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFBF
 :10015000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFAF
 :10016000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF9F
 :10017000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF8F
 :10018000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF7F
 :10019000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF6F
 :1001A000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF5F
 :1001B000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF4F
 :1001C000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF3F
 :1001D000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF2F
 :1001E000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1F
 :1001F000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF0F
 :10020000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFE
 :10021000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFEE
 :10022000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFDE
 :10023000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFCE
 :10024000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFBE
 :10025000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFAE
 :10026000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF9E
 :10027000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF8E
 :10028000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF7E
 :10029000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF6E
 :1002A000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF5E
 :1002B000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF4E
 :1002C000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF3E
 :1002D000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF2E
 :1002E000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1E
 :1002F000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF0E
 :10030000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFD
 :10031000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFED
 :10032000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFDD
 :10033000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFCD
 :10034000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFBD
 :10035000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFAD
 :10036000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF9D
 :10037000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF8D
 :10038000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF7D
 :10039000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF6D
 :1003A000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF5D
 :1003B000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF4D
 :1003C000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF3D
 :1003D000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF2D
 :1003E000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1D
 :1003F000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF0D
 :00000001FF
```

(When ROM capacity is in 1,024 steps)

*Note The size of the object file differs depending on the device and the ROM capacity. Refer to the "S5U1C62xxxD Manual".*

# IV

## MELODY ASSEMBLER

# MLA628X

This part mainly explains how to operate the Melody Assembler MLA628X for the S1C62 Family, and how to generate source files.

# MELODY ASSEMBLER MLA628X

## Contents

# 1 DIFFERENCES DEPENDING ON THE MODEL

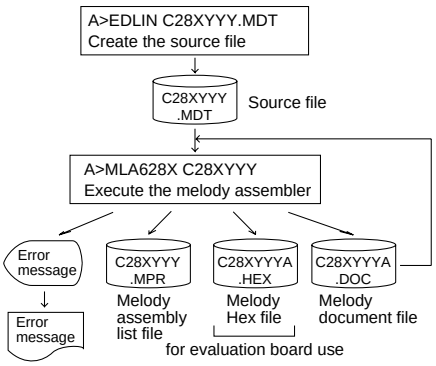
The MLA628X is not included in the software tools for models (other than the S1C62N8X) that do not have the melody function.
The melody ROM capacity varies depending on the model in models (S1C62N8X) having the melody function. You should be aware that the number of melody data and their bit structure will vary, as a result. The limiting items for each model are indicated in the "S5U1C62N8xD Manual".

# 2 MLA628X OUTLINE

## 2.1 Outline and Execution Flow

The Melody Assembler MLA628X is an assembler that outputs melody ROM data of the 4-bit single-chip microcomputers S1C628XX Series. MLA628X assembles the source file which has been input by the user's editor and outputs the object file in Intel-HEX format as well as the assembly list file and document file.
The Melody Assembler's program name is "MLA628X.EXE".
Figure 2.1.1 shows the flow of executing MLA628X.

*Fig. 2.1.1 MLA628X execution flow*




## 2.2 MLA628X Input/Output Files

MLA628X inputs the source file, and after assembly it outputs the melody HEX file, assembly list file and document file.

### ■ Source file (C28XYYY.MDT)

This is a source program file of the melody data. Generate the source file using an editor such as EDLIN while referencing the Chapter 3.

### ■ Melody HEX file (C28XYYYA.HEX)

This is a melody data file (Intel hexa format) used for the evaluation board (S5U1C62N8xE). One melody ROM is generated by writing this file with the ROM writer.
Also, this file can be loaded into the evaluation board through the ICE by using the OPTLD command.

*Note: Set all unused ROM areas to FFH when writing the HEX file into EPROM.*

When loaded with ICE, the file format is checked, and an error results when it outside the specifiable range is specified. Refer to the "S5U1C62N8xD Manual" for the restrictions of each models.

### ■ Melody assembly list file (C28XYYY.MPR)

Melody ROM list file with melody ROM data and error messages (if any) added to each line of the source file. The scale ROM table can be created at the end of the file.

### ■ Melody document file (C28XYYYA.DOC)

This is a data file used to generate the mask patterns. Combine the completed document file with the program files and option document files using the mask data checker MDC628X, and submit to Seiko Epson.

# 3 STARTING MLA628X

To starting MLA628X, enter the following at the DOS command level (when a prompt such as A> is being displayed):

**MLA628X_[drive name:]source filename[.shp]_[-H]↵**

*_ indicates a blank.*
*A parameter enclosed by [ ] can be omitted.*
*↵ indicates the return key.*

When starting MLA628X through the DMS6200, selects the "MLA628X.EXE" and source file in the menu screen, and input options necessary.

### ■ Drive name

When the source file is in a different drive from MLA628X.MDT, the drive name is input before the source filename. If in the same drive, then it may be omitted.

### ■ Source filename

The source file to input to MLA628X.
*Note Make the source filename up to seven characters long, and do not input the extension (".MDT").*

### ■ .shp

Characters s, h, and p are options specifying the file's input / output drive, as explained below. These may be omitted, and input is valid for both upper- and lower-case.

s: Specifies the drive from A through P that inputs the source file.
When "@" is specified, the source file on the current drive (directory) is input.
The "s" specification is valid when the drive name is input before the source filename.

h: Specifies the drive from A through P that outputs the melody HEX file and melody document file.
When "@" is specified, output is made to the current drive (directory).
When "Z" is specified, only assembly is performed and the melody HEX file and melody document file are not created.

p: Specifies the drive from A through P that outputs the assembly list file.
When "@" is specified, output is made to the current drive (directory).
When "X" is specified the list including error messages is output from the console.
When "Z" is specified, the assembly list file is not created.

Specify s, h and p at the same time. These cannot be specified separately.

### ■ -H option

"-H" is the option to indicate activation of the conversion program from the melody document file to the melody HEX file.
When this option is specified, the [shp] option is disabled. The melody document file of the current drive is input and the melody HEX file is created for the current drive. Input can be in upper- and lower-case.

Examples:

A>MLA628X C28XYYY↵
In this example, the source file "C28XYYY.MDT" is input from drive A, and the melody HEX file "C28XYYYA.HEX", melody assembly list file "C28XYYY.MPR", and melody document file "C28XYYYA.DOC" are created on drive A.

A>MLA628X B:C28XYYY↵
In this example, the source file "C28XYYY.MDT" is input from drive B, and the melody HEX file "C28XYYYA.HEX", melody assembly list file "C28XYYY.MPR", and melody document file "C28XYYYA.DOC" are created on drive B.

A>MLA628X C28XYYY.BBZ↵
In this example, the source file "C28XYYY.MDT" is input from drive B, and the melody HEX file "C28XYYYA.HEX" and melody document file "C28XYYYA.DOC" are created on drive B. The melody assembly list is not created.

When MLA628X is activated, the activation messages appear as shown below.

```
A>MLA628X C28X0A0
          ***  MLA628X MELODY ASSEMBLER. --- Ver 3.10  ***

EEEEEEEEEE    PPPPPPPP          SSSSSSS        OOOOOOOO       NNN     NNN
EEEEEEEEEE    PPPPPPPPPP       SSS   SSSS     OOO    OOO      NNNN    NNN
EEE           PPP     PPP     SSS     SSS    OOO      OOO     NNNNN   NNN
EEE           PPP     PPP      SSS           OOO      OOO     NNNNNN  NNN
EEEEEEEEEE    PPPPPPPPPP        SSSSSS       OOO      OOO     NNN NNN NNN
EEEEEEEEEE    PPPPPPPP             SSSS      OOO      OOO     NNN  NNNNNN
EEE           PPP                    SSS     OOO      OOO     NNN   NNNNN
EEE           PPP              SSS     SSS    OOO      OOO     NNN    NNNN
EEEEEEEEEE    PPP              SSSS   SSS      OOO    OOO      NNN     NNN
EEEEEEEEEE    PPP                SSSSSSS        OOOOOOOO       NNN      NN

                (C) COPYRIGHT 1991 SEIKO EPSON CORP.

            SOURCE FILE NAME IS " C28XYYYA.MDT ".

            THIS SOFTWARE MAKES NEXT FILES.

               C28XYYYA.HEX  ...  MELODY HEX FILE.
               C28XYYYA.DOC  ...  MELODY DOCUMENT FILE.
               C28XYYY .MPR  ...  MELODY ASSEMBLY FILE.


                           STRIKE ANY KEY
```

Example:
When assembling C28X0A0.MDT (Basic assembly)

With the message "STRIKE ANY KEY", the program is requesting key input for confirmation.

The program will proceed when any key is pressed.
To cancel the program, press the "CTRL" and "C" keys together. This will return you to the DOS command level.

```
A>MLA628X C28X0A0 -H
          ***  MLA628X MELODY ASSEMBLER. --- Ver 3.10  ***

EEEEEEEEEE    PPPPPPPP          SSSSSSS        OOOOOOOO       NNN     NNN
EEEEEEEEEE    PPPPPPPPPP       SSS   SSSS     OOO    OOO      NNNN    NNN
EEE           PPP     PPP     SSS     SSS    OOO      OOO     NNNNN   NNN
EEE           PPP     PPP      SSS           OOO      OOO     NNNNNN  NNN
EEEEEEEEEE    PPPPPPPPPP        SSSSSS       OOO      OOO     NNN NNN NNN
EEEEEEEEEE    PPPPPPPP             SSSS      OOO      OOO     NNN  NNNNNN
EEE           PPP                    SSS     OOO      OOO     NNN   NNNNN
EEE           PPP              SSS     SSS    OOO      OOO     NNN    NNNN
EEEEEEEEEE    PPP              SSSS   SSS      OOO    OOO      NNN     NNN
EEEEEEEEEE    PPP                SSSSSSS        OOOOOOOO       NNN      NN

                (C) COPYRIGHT 1991 SEIKO EPSON CORP.

            SOURCE FILE NAME IS " C28XYYYA.DOC ".

            THIS SOFTWARE MAKES NEXT FILES.

               C28XYYYA.HEX  ...  MELODY HEX FILE.


                           STRIKE ANY KEY
```

Example:
-H option use (activation of program to convert melody document file to melody HEX file)

With the message "STRIKE ANY KEY", the program is requesting key input for confirmation. Check the source filename and option that you have input.

The program will proceed when any key is pressed. To cancel the program, press the "CTRL" and "C" keys together. This will return you to the DOS command level.

# 4 FORMAT OF SOURCE FILE

Contents of the source file, created with an editor such as EDLIN, are configured from the S1C628XX melody codes and the pseudo-instructions described later.

## 4.1 Source File Name

The source file can be named with a maximum of any seven characters. As a rule, keep to the following format.

**C28XYYY.MDT**

Three alphanumerics are entered in the "YYY" part. Refer to the model name from Seiko Epson. The extension must be ".MDT".

## 4.2 Statement (line)

Write each of the source file statements (lines) as follows:

Basic format: **<Attack> <Note> <Scale> <End bit> <; comment>**

Example:

```
.TEMPC0=5
.TEMPC1=8
.OCTAVE=32
;
1           1           C3
:           :           :
0           6           A4#         1           ;1st Melody
:           :           :
```

Attack field | Note field | Scale field | End bit field | Comment field

The statement is made up of the five fields: attack field, note field, scale field, end bit field, and comment field. Up to 80 characters can be written in the statement. The fields are separated by one or more spaces or by inserting tabs.
The end bit fields and comment fields can be filled in on an as-needed basis.
A blank line is also permitted for the CR (carriage return) code only. However, it is not permitted on the last line. Each of the fields can be started from any column.

### (1) Attack field

Control of the attack output is written.
When "1" is written, attack output is performed. When "0" is written, attack output is not performed.

### (2) Note field

*Table 4.2.1 Notes and corresponding codes*

| No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Note |  |  |  |  |  |  |  |  |

Eight notes can be specified with the 3 bits melody data. Fill in the note field with numbers from 1 to 8.

*Table 4.2.2 Rests and corresponding codes*

| No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Rest |  |  |  |  |  |  |  |  |

When the "RR" (rest) is described in scale field, the rest may be selected from among 8 types as shown in Table 4.2.2.

### (3) Scale field

The scale field can be filled in with any scale (C3 through C6#).
When inputting the scale data directly, prefix the data with "$". In this case, the input data range is 00H through FDH.
Moreover, the rest may be selected by describes "RR" in the scale field.
The number of specifiable scales varies depending on the model.
(Refer to the "S5U1C62N8xD Manual".)

### (4) End bit field

The instruction indicating the end of the melody is written in the end bit field. When "1" is written, the melody finishes with the melody data of that address. Otherwise, write "0", or omit it altogether.

### (5) Comment field

Any comment, such as the program index or processing details, can be written in the comment field, with no affect on the object file created with the assembler.
The comment field is the area between the semicolon ";" and the CR code at the end of the line.
A line can be made up of a comment field alone. However, if the comment extends into two or more lines, each line must be headed with a semicolon.

### (6) Fields and corresponding melody data

**** Melody data***

| MSB | 3 bits | Number of bit is difference depending the model | LSB |
|---|---|---|---|
| 1/0 | 0–8 | 0–X (Refer to the "S5U1C62N8xD Manual".) | 1/0 |
| Attack data | Note data | Scale address data | End data |

- End data  Becomes "0" when "0" is entered or no entry is made; otherwise, "1".
- Scale address data

| Scale | Scale Data | | | | | | | | Scale | Scale Data | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S7 | S6 | S5 | S4 | S3 | S2 | S1 | S0 | Hex. | | S7 | S6 | S5 | S4 | S3 | S2 | S1 | S0 | Hex. |
| C3 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 04 | G4 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | B1 |
| C3# | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 12 | G4# | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | B5 |
| D3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 20 | A4 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | B8 |
| D3# | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 2F | A4# | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | BC |
| E3 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 3B | B4 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | C0 |
| F3 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 44 | C5 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | C4 |
| F3# | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 51 | C5# | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | C8 |
| G3 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 5B | D5 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | CD |
| G3# | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 65 | D5# | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | CE |
| A3 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 6C | E5 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | D3 |
| A3# | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 74 | F5 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | D4 |
| B3 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 7C | F5# | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | D9 |
| C4 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 84 | G5 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | DB |
| C4# | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 8D | G5# | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | DC |
| D4 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 92 | A5 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | DE |
| D4# | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 98 | A5# | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | E0 |
| E4 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 9E | B5 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | E2 |
| F4 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | A4 | C6 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | E4 |
| F4# | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | AB | C6# | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | E6 |

*Table 4.2.3*
*Correspondence between scale and scale data*

The scale or scale data written in the scale field is loaded into the scale ROM, and the address of the loaded scale data becomes the scale address data.

- Note data

| Note Data | 111 | 110 | 101 | 100 | 011 | 010 | 001 | 000 |
|---|---|---|---|---|---|---|---|---|
| Note |  |  |  |  |  |  |  |  |

*Table 4.2.4*
*Correspondence between notes and note data*

The correspondence between notes and note data are as follows.

- Attack data  "0" or "1" written in the attack field becomes the attack data.

# 5 PSEUDO-INSTRUCTIONS

The pseudo-instruction is for the assembler, and cannot be executed by the melody data after development.
In the explanations below, the symbols "<" and ">" used in the pseudo-instruction format indicate the contents of the statement. These symbols are not actually written. "_" indicates one or more spaces or tabs. The symbol, constant, arithmetic expression and so forth is written in "<expression>".

## 5.1 Address-Setting Pseudo-Instruction

### ■ ORG (ORIGIN)

| *ORG_<Expression>* | *Sets location counter* |
|---|---|

The ORG instruction sets the value of <expression> in the location counter.
If the ORG instruction does not head the source file, the location counter is set to 0 and assembly is performed. The ORG instruction can be used in multiple places in the program. However, it cannot be set in a location ahead of the current location counter, otherwise all the statements will be invalid until the next correct setting is performed, and "!" (Warning) is displayed.
When a value exceeding the ROM capacity is specified, an R error results.

## 5.2 Option-Setting Pseudo-Instructions

### ■ Tempo selection

The 2 types of tempo may be selected from among 16 types by using the option-setting pseudo-instructions (".TEMPC0 = n") and (".TEMPC1 = n").
The option-setting pseudo-instructions and the corresponding tempo generated are shown in Table 5.2.1.
The 2 types of tempo for TEMPC0 and TEMPC1 are selected by specifying n.
The proper use of the 2 types of tempo selected is specified through the software.
The 2 types of tempo which may selected are: TEMPC0 to be played when "0" is written on the TEMPC register (address: F2H, data bit: D1) and the TEMPC1 to be played when "1" is written on the said register.

*Table 5.2.1 Tempo setting*

| Tempo symbol | Option-setting pseudo-instruction | Tempo symbol | Option-setting pseudo-instruction |
|---|---|---|---|
| ♩ ≒ 30 | .TEMPC0 = 0<br>.TEMPC1 = 0 | ♩ ≒ 60 | .TEMPC0 = 8<br>.TEMPC1 = 8 |
| ♩ ≒ 32 | .TEMPC0 = 1<br>.TEMPC1 = 1 | ♩ ≒ 68.6 | .TEMPC0 = 9<br>.TEMPC1 = 9 |
| ♩ ≒ 34.3 | .TEMPC0 = 2<br>.TEMPC1 = 2 | ♩ ≒ 80 | .TEMPC0 = 10<br>.TEMPC1 = 10 |
| ♩ ≒ 36.9 | .TEMPC0 = 3<br>.TEMPC1 = 3 | ♩ ≒ 96 | .TEMPC0 = 11<br>.TEMPC1 = 11 |
| ♩ ≒ 40 | .TEMPC0 = 4<br>.TEMPC1 = 4 | ♩ ≒ 120 | .TEMPC0 = 12<br>.TEMPC1 = 12 |
| ♩ ≒ 43.6 | .TEMPC0 = 5<br>.TEMPC1 = 5 | ♩ ≒ 160 | .TEMPC0 = 13<br>.TEMPC1 = 13 |
| ♩ ≒ 48 | .TEMPC0 = 6<br>.TEMPC1 = 6 | ♩ ≒ 240 | .TEMPC0 = 14<br>.TEMPC1 = 14 |
| ♩ ≒ 53.3 | .TEMPC0 = 7<br>.TEMPC1 = 7 | ♩ ≒ 480 | .TEMPC0 = 15<br>.TEMPC1 = 15 |

### ■ .TEMPC0

| *.TEMPC0=n* | *Sets TEMPC0 (n = 0–15)* |
|---|---|

The TEMPC0 option is set by specifying n as an integer in the range 0 to 15.
This setting cannot be omitted.

### ■ .TEMPC1

| | |
|---|---|
| ***.TEMPC1 = n*** | ***Sets TEMPC1 (n = 0–15)*** |

The TEMPC1 option is set by specifying n as an integer in the range 0 to 15.
This setting cannot be omitted.

### ■ .OCTAVE

| | |
|---|---|
| ***.OCTAVE = m*** | ***Sets scale range (m = 32 or 64)*** |

Decides the scale range by selecting the specification of the melody multiplier circuit.
The specification becomes 32 kHz for m = 32, and the range becomes (C3–C6#).
The specification becomes 64 kHz for m = 64, enabling output of notes one octave higher (C4–C7#) than can be done with the 32 kHz specification.
For instance, even if the scale in the source file is C5, the actual sound generated will be C6.
This setting cannot be omitted.

# 6 ERROR MESSAGES

When errors occur during assembly, MLA628X outputs the following error symbols or error messages to the console and assembly list file.
Just one error symbol is output at the head (first column) of the statement that generated an error. (When multiple errors have been generated, the symbol for the error of highest priority is output.)

The following error symbols are shown in order from highest priority.

### ■ Error symbol (errors that can be assembled)

- S (Syntax error)..... Major syntax error.
  Error in scale field ..... Exceeded scale range: C3–C6#
  Error in note field ..... Exceeded note range: 1–8
  Error in attack field ..... Number other than 0 or 1 was input.
  Error in end bit field..... Number other than 0 or 1 was input.
- O (Scale ROM overflow) ..... The definition exceeded the scale ROM capacity.
- R (Range error) ..... The value of the location counter exceeded the upper limit of the melody ROM capacity. Otherwise, the specified location exceeded the upper limit.

### ■ Error messages (Fatal errors preventing assembly or output of assembly results)

- OPTION COMMAND MISSING .... Options cannot be set.
- FILE NAME ERROR ..... The source filename has eight or more characters.
- FILE NOT PRESENT ..... The specified source file is not there.
- DIRECTORY FULL ..... No more room in the directory of the specified disk.
- FATAL DISK WRITE ERROR ..... The file cannot be written to the disk.

# *APPENDIX SAMPLE FILES*

The following input/output files are an example for the MLA6282 case and the data size, etc. will vary depending on the model.

## ■ Example of Source File

```
.TEMPC0=5
.TEMPC1=8
.OCTAVE=32
;
1 1 C3      ;
0 4 D4      ;
0 4 F4      ;
0 2 F5      ;
0 3 G5#     ;
1 7 A4      ;
1 5 B4      ;
0 6 A4# 1   ;    1st Melody
;
ORG 10H
;
1 2 $C3     ;
0 3 $45     ;
0 7 $E3     ;
1 6 $97     ;
0 5 C6      ;
0 7 A5#     ;
1 3 $42 1   ;    2nd Melody
```

## ■ Example of Assembly List

```
LISTING OF MLA6282      C282YYY.MPR  1991-6-01 14:25...PAGE   1
                                                          Time
                                                   Date
                                            File specifier of melody assembly list
  ADRS  CODE      SOURCE

                .TEMPC0 = 5
                .TEMPC1 = 8
                .OCTAVE = 32
                ;
  00    3C0      1 1 C3     ;
  01    102      0 4 D4     ;
  02    104      0 4 F4     ;
  03    186      0 2 F5     ;
  04    148      0 3 G5#    ;
  05    24A      1 7 A4     ;
  06    2CC      1 5 B4     ;
  07    08F      0 6 A4# 1  ;    1st Melody
                ;
                ORG 10H
                ;
  10    390      1 2 $C3    ;
  11    152      0 3 $45    ;
  12    054      0 7 $E3    ;
  13    296      1 6 $97    ;
  14    0D8      0 5 C6     ;
  15    05A      0 7 A5#    ;
  16    35D      1 3 $42 1  ;    2nd Melody

0 ERROR(S) DETECTED
```

```
SCALE ROM TABLE      PAGE S-1

ADRS     SCALE       CODE

00000      C3          04
00001      D4          92
00010      F4          A4
00011      F5          D4
00100      G5#         DC
00101      A4          B8
00110      B4          C0
00111      A4#         BC
01000      $C3         C3
01001      $45         45
01010      $E3         E3
01011      $97         97
01100      C6          E4
01101      A5#         E0
01110      $42         42
01111      --          FF
10000      --          FF
10001      --          FF
10010      --          FF
10011      --          FF
10100      --          FF
10101      --          FF
10110      --          FF
10111      --          FF
11000      --          FF
11001      --          FF
11010      --          FF
11011      --          FF
11100      --          FF
11101      --          FF
11110      --          FF
11111      RR          C4
```

Example of scale ROM table
- Hyphens "--" indicate unused code.
- When unused, the code is FFH.
- The last location, ADRS = "11111", of the scale ROM is fixed at SCALE = "RR" and CODE = "C4".

## ■ Example of Melody Hex File Data Format

```
:10000000010101010102020 0FFFFFFFFFFFFFFFFEF
:10001000010100020000003FFFFFFFFFFFFFFFFFE2
:10002000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFE0
:10003000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFD0
:10004000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFC0
:10005000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFB0
:10006000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFA0
:10007000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF90
:10008000C0020486484ACC8FFFFFFFFFFFFFFFF3F
:1000900090525496D85A5DFFFFFFFFFFFFFFFF0E
:1000A000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF60
:1000B000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF50
:1000C000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF40
:1000D000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF30
:1000E000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF20
:1000F000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF10
:100100000492A4D4DCB8C0BCC345E397E4E042FF4A
:10011000FFFFFFFFFFFFFFFFFFFFFFFFFFFFC42A
:100120000508FFFFFFFFFFFFFFFFFFFFFFFFFFD0
:1001300000FFFFFFFFFFFFFFFFFFFFFFFFFFFFCE
:00000001FF
```

Main ROM high-order (D8, D9)

Main ROM low-order (D0–D7)

Scale ROM (D0–D7)

Option - Tempo
- Octave

## ■ Example of Assembly List When Error Occurs

When an error occurs the code is made FFF forcibly. A value is not entered for the scale ROM.

```
LISTING OF MLA6282      C282YYY.MPR  1991-6-01 17:30...PAGE   1

  ADRS  CODE      SOURCE

                .TEMPC0 = 5
                .TEMPC1 = 8
                .OCTAVE = 32
                ;
   0    000      0 1 C3      ;♪
   1    062      0 4 D4      ;♩
   2    064      0 4 F4      ;♩
S  3    FFF      0 2 F6      ;♪
   4    048      0 3 G5#     ;♪
S  5    FFF      2 7 A4      ;♩.
S  6    FFF      1 9 B4      ;
   7    0A9      0 6 A4# 1   ;♩.   1st Melody
                ;
                ORG 10H
                ;
  10    02A      0 2 $C3     ;♪
  11    06C      0 3 $17     ;♪
  12    0CE      0 7 $E3     ;♩.
  13    1B0      1 6 $97     ;♩.
  14    092      0 5 C6      ;♩♬
  15    0D4      0 7 A5#     ;♩.
  16    056      0 3 E3      ;♪
  17    078      0 4 G5      ;♩
  18    09A      0 5 G4      ;♩♬
  19    07C      0 4 G4#     ;♩
O 1A    FFF      0 3 A4      ;♪
  1B    15F      1 3 RR 1    ;♪   2nd Melody
      :
      :
      :
  4E    05A      0 3 G4      ;♪
  4F    05A      0 3 G4      ;♪
R 50    FFF      0 3 G4      ;♪
S 51    FFF      4 3 G4      ;♪
R 52    FFF      0 3 G4 1    ;♪

7 ERROR(S) DETECTED
```

```
SCALE ROM TABLE      PAGE S-1

ADRS     SCALE       CODE

00000      C3          04
00001      D4          92
00010      F4          A4
00011      F5          D4
00100      G5#         DC
00101      A4          B8
00110      B4          C0
00111      A4#         BC
01000      $C3         C3
01001      $45         45
01010      $E3         E3
01011      $97         97
01100      C6          E4
01101      A5#         E0
01110      $42         42
01111      --          FF
10000      --          FF
10001      --          FF
10010      --          FF
10011      --          FF
10100      --          FF
10101      --          FF
10110      --          FF
10111      --          FF
11000      --          FF
11001      --          FF
11010      --          FF
11011      --          FF
11100      --          FF
11101      --          FF
11110      --          FF
11111      RR          C4
```

## ■ Example of Melody Document File Format

```
:10000000010101010102020 0FFFFFFFFFFFFFFFEF
:1000100001010002000003FFFFFFFFFFFFFFFFFE2
:10002000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFE0
:10003000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFD0
:10004000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFC0
:10005000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFB0
:10006000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFA0
:10007000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF90
:00000001FF
```

Main ROM (high side)
Intel hexadecimal format

```
:10000000C0020486484ACC8FFFFFFFFFFFFFFFFBF
:1000100090525496D85A5DFFFFFFFFFFFFFFFF8E
:10002000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFE0
:10003000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFD0
:10004000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFC0
:10005000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFB0
:10006000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFA0
:10007000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF90
:00000001FF
```

Main ROM (low side)
Intel hexadecimal format

```
:100000000492A4D4DCB8C0BCC345E397E4E042FF4B
:10001000FFFFFFFFFFFFFFFFFFFFFFFFFFFFC42B
:00000001FF
```

Scale ROM
Intel hexadecimal format

```
*   E0C6282 MELODY OPTION DOCUMENT V.3.10
*
* OPTION NO.20
*   OCTAVE CIRCUIT
*    32KHZ -------------------- SELECTED
OPT2001 01
*
* OPTION NO.21
*   < MELODY TEMPO SELECTION >
*   TEMPC0 TEMPO 5 ------------ SELECTED
*   TEMPC1 TEMPO 8 ------------ SELECTED
OPT2101 03
OPT2102 04
OPT2103 02
OPT2104 04
\\END
```

Option selection

*Note End mark "¥¥END" may be used instead of "\\END" depending on the PC used. (Because the code of both \ and ¥ is 5CH.)*

# V

## FUNCTION OPTION GENERATOR

# FOG62XX

This part mainly explains how to operate the Function Option Generator FOG62XX for setting the hardware options of the S1C62 Family.

# FUNCTION OPTION GENERATOR FOG62XX

## Contents

# 1 DIFFERENCES DEPENDING ON THE MODEL

The set option content will vary depending on the model.
Here only the operation will be explained, so you should refer to the "S5U1C62xxxD Manual" concerning the option specifications and the selection screen.

# 2 FOG62XX OUTLINE

## 2.1 Outline of Function Option Generator

With the 4-bit single-chip S1C62XXX microcomputers, the customer may select hardware options. By modifying the mask patterns of the S1C62XXX according to the selected options, the system can be customized to meet the specifications of the target system.
The FOG62XX Option Generator (hereinafter called FOG62XX) is a software tool for generating data files used to generate mask patterns. It enables the customer to interactively select and specify pertinent items for each hardware option. From the data file created with FOG62XX, the S1C62XXX mask pattern is automatically generated by a general purpose computer.
The HEX file for the evaluation board (S5U1C62xxxE) hardware option ROM is simultaneously generated with the data file. By writing the contents of the HEX file into the EPROM and mounting it on the evaluation board, option functions can be executed on the evaluation board.

The program name of FOG62XX is as follows:

FOG62XX.EXE

Figure 2.1.1 shows the FOG62XX execution flow.

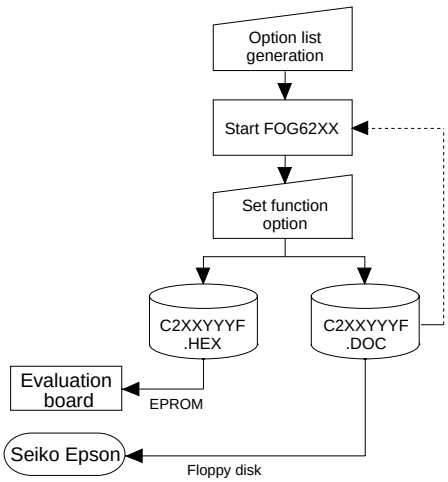



*Fig. 2.1.1 FOG62XX execution flow*

## 2.2 FOG62XX Input/Output Files

Function options can be interactively selected, so an input file need not be generated. Select the hardware options that meet the specifications of the target system and record them in the option list (paper for recording items in preparation for input operation; explained later).
FOG62XX outputs the following data files:

- **Function option document file (C2XXYYYF.DOC)**
  This is a data file used to generate the mask patterns for such items as I/O ports. This file must be sent with the completed program file. Already selected options can be modified.
- **Function option HEX file (C2XXYYYF.HEX)**
  This is a function option file (Intel hexa format) used for evaluation board. One evaluation board function option ROM is generated by writing this file with the ROM writer.

*Remarks:*
- *File name "YYY" is specified for each customer by Seiko Epson.*
- *Combine the document files with the program files (C2XXYYYH.HEX and C2XXYYYL.HEX) using the mask data checker (MDC62XX): copy the combined file into another diskette and submit to Seiko Epson.*
- *Set all unused ROM areas to FFH when writing the HEX file into the EPROM. (Refer to "S5U1C62xxxE Manual" for the ROM installation location.)*

# 3 OPTION LIST GENERATION

## 3.1 Option List Recording Procedure

Multiple specifications are available in each option item as indicated in the Option List Example in Section 3.2. Using the "S5U1C62xxxD Manual" as reference, select the specifications that meet the target system and check the appropriate box. Be sure to record the specifications for unused ports too, according to the instructions provided.
Select the function options on the screen while referencing the option list.

## 3.2 Option List Example

The following is an example of option list. Refer to the "S5U1C62xxxD Manual" for the option list of each model.

**1. DEVICE TYPE**

☐ 1. E0C62XX
☐ 2. E0C62LXX

**2. MULTIPLE KEY ENTRY RESET**

- COMBINATION ..... ☐ 1. Not Use
☐ 2. Use K00, K01
☐ 3. Use K00, K01, K02
☐ 4. Use K00, K01, K02, K03

**3. INTERRUPT NOISE REJECTOR**

- K00–K03 ..... ☐ 1. Use ☐ 2. Not Use

**4. INPUT PORT PULL DOWN RESISTOR**

- K00 ..... ☐ 1. With Resistor ☐ 2. Gate Direct
- K01 ..... ☐ 1. With Resistor ☐ 2. Gate Direct
- K02 ..... ☐ 1. With Resistor ☐ 2. Gate Direct
- K03 ..... ☐ 1. With Resistor ☐ 2. Gate Direct

**5. R00 SPECIFICATION**

- OUTPUT TYPE ..... ☐ 1. D.C.
☐ 2. Buzzer Inverted Output (Control bit is R00)
☐ 3. Buzzer Inverted Output (Control bit is R01)
- OUTPUT SPECIFICATION ..... ☐ 1. Complementary ☐ 2. Pch Open Drain

**6. R01 SPECIFICATION**

- OUTPUT TYPE ..... ☐ 1. D.C. ☐ 2. Buzzer Output
- OUTPUT SPECIFICATION ..... ☐ 1. Complementary ☐ 2. Pch Open Drain

**7. OUTPUT PORT OUTPUT SPECIFICATION (R02, R03)**

- R02 ..... ☐ 1. Complementary ☐ 2. Pch Open Drain
- R03 ..... ☐ 1. Complementary ☐ 2. Pch Open Drain

:

# 4 FOG62XX OPERATION PROCEDURE

## 4.1 Starting FOG62XX

To start FOG62XX, enter the following at DOS command level (state in which a prompt such as A> is displayed):

```
A>FOG62XX↵
```

↵ *indicates the return key.*

When starting FOG62XX through the DMS6200, selects the "FOG62XX.EXE" in the menu screen.

When FOG62XX is started, the following message is displayed.

```
        ***  E0C62XX FUNCTION OPTION GENERATOR. --- Ver 3.02  ***

    EEEEEEEEEE   PPPPPPPP        SSSSSSS       OOOOOOOO     NNN     NNN
    EEEEEEEEEE   PPPPPPPPPP     SSS   SSSS    OOO    OOO    NNNN    NNN
    EEE          PPP     PPP   SSS     SSS   OOO      OOO   NNNNN   NNN
    EEE          PPP     PPP    SSS          OOO      OOO   NNNNNN  NNN
    EEEEEEEEEE   PPPPPPPPPP      SSSSSS      OOO      OOO   NNN NNN NNN
    EEEEEEEEEE   PPPPPPPP           SSSS     OOO      OOO   NNN  NNNNNN
    EEE          PPP                SSS     OOO      OOO   NNN   NNNNN
    EEE          PPP            SSS     SSS   OOO      OOO   NNN    NNNN
    EEEEEEEEEE   PPP            SSSS    SSS    OOO    OOO    NNN     NNN
    EEEEEEEEEE   PPP              SSSSSSS       OOOOOOOO     NNN      NN

                  (C) COPYRIGHT 1991  SEIKO EPSON CORP.

              THIS SOFTWARE MAKES NEXT FILES.

                 C2XXYYYF.HEX  ...  FUNCTION OPTION HEX FILE.
                 C2XXYYYF.DOC  ...  FUNCTION OPTION DOCUMENT FILE.

                              STRIKE ANY KEY.
```

For "STRIKE ANY KEY," press any key to advance the program execution. To suspend execution, press the "CTRL" and "C" keys together: the sequence returns to the DOS command level. (It is possible by pressing "STOP" key depending on the PC used.)

Following the start message, the date currently set in the personal computer is displayed, prompting entry of a new date.

```
    *** E0C62XX USER'S OPTION SETTING. --- Ver 3.02 ***

    CURRENT DATE IS  91/07/19
    PLEASE INPUT NEW DATE  :   91/07/22↵
```

When modifying the date, enter the 2-digit year, month, and day of the month by delimiting them with a slash ("/").
When not modifying the date, press the RETURN key "↵" to continue.

When the date is set, the following operation selection menu is displayed on the screen.

```
*** OPERATION SELECT MENU ***

        1. INPUT NEW FILE
        2. EDIT FILE
        3. RETURN TO DOS

PLEASE SELECT NO.?
```

Enter a number from 1 to 3 to select a subsequent operation. The items indicate the following.

1. INPUT NEW FILE: Used to set new function options.
2. EDIT FILE: Used to read the already-generated function option document file and set or modify the option contents. In this case, the work disk must contain the function option document file (C2XXYYYF.DOC) generated by "1. INPUT NEW FILE".
3. RETURN TO DOS: Used to terminate FOG62XX and return to the DOS command level.

## *4.2 Setting New Function Options*

This section explains how to set new function options.

```
*** OPERATION SELECT MENU ***

        1. INPUT NEW FILE
        2. EDIT FILE
        3. RETURN TO DOS

PLEASE SELECT NO.? 1↵                                          ..(1)
PLEASE INPUT FILE NAME? C2XXYYY↵                               ..(2)
PLEASE INPUT USER'S NAME? SEIKO EPSON CORP.↵                   ..(3)
PLEASE INPUT ANY COMMENT
(ONE LINE IS 50 CHR)? TOKYO DESIGN CENTER↵                     ..(4)
                    ? 421-8 HINO HINO-SHI TOKYO 191 JAPAN↵
                    ? ↵
```

### (1) PLEASE SELECT NO.?

Select "1. INPUT NEW FILE" on the operation selection menu.

### (2) PLEASE INPUT FILE NAME?

Enter the file name. Do not enter the extended part of the file name. In case a function option document file (C2XXYYY.DOC) with the same name as the file name specified in the current drive exists, the user is asked whether overwrition is desired. Enter "Y" or "N" accordingly.

Example:
```
PLEASE INPUT FILE NAME? C2XXYYY↵
EXISTS OVERWRITE (Y/N)?
```

### (3) PLEASE INPUT USER'S NAME?

Enter the customer's company name.

### (4) PLEASE INPUT ANY COMMENT

Enter any comment. Up to 50 characters may be entered in one line. If 51 or more characters are entered in one line, they are ignored. Up to 10 comment lines may be entered. To end entry of comments, press the RETURN key "↵". Include the following in comment lines:

- Company, department, division, and section names
- Company address, phone number, and FAX number
- Other information, including technical information

Next, start function option setting. For new settings, select function options from No. 1 to last number sequentially and interactively. Refer to the "S5U1C62xxxD Manual" for the option selection procedure.

## *4.3 Modifying Function Option Settings*

This section explains how to modify the function option settings.

```
*** OPERATION SELECT MENU ***

        1. INPUT NEW FILE
        2. EDIT FILE
        3. RETURN TO DOS

PLEASE SELECT NO.? 2↵                                   ..(1)

*** SOURCE FILE(S) ***

C2XX0A0         C2XX0B0         C2XX0C0                 ..(2)

PLEASE INPUT FILE NAME? C2XXYYY↵                        ..(3)
PLEASE INPUT USER'S NAME? ↵                             ..(4)
PLEASE INPUT ANY COMMENT
(ONE LINE IS 50 CHR)? ↵                                 ..(5)
PLEASE INPUT EDIT NO.? 4↵                               ..(6)
```

### (1) PLEASE SELECT NO.?

Select "2. EDIT FILE" on the operation selection menu.

### (2) *** SOURCE FILE(S) ***

Will display the function option document files on the current drive.
If no modifiable source exists, the following message is displayed and the program is terminated.

```
FUNCTION OPTION DOCUMENT FILE IS NOT FOUND.
```

### (3) PLEASE INPUT FILE NAME?

Enter a file name. Do not enter the extended part of the file name. If the function option document file (C2XXYYYF.DOC) is not in the current drive, an error message like the one below is output, prompting entry of other file name.

Example:
```
PLEASE INPUT FILE NAME? C2XX0N0↵
FUNCTION OPTION DOCUMENT FILE IS NOT FOUND.
```

### (4) PLEASE INPUT USER'S NAME?

When modifying the customer's company name, enter a new name. The previously entered name may be used by pressing the RETURN key "↵".

### (5) PLEASE INPUT ANY COMMENT

When modifying a comment, enter all the comment lines anew, beginning with the first line; comment data cannot be partially modified. Previously entered comment data can be used by pressing the RETURN key "↵". The input condition are the same as for new settings.

### (6) PLEASE INPUT EDIT NO.?

Enter the number of the function option to be modified, then start setting the option contents.

When selection of one option is complete, the system prompts entry of another function option number. Repeat selection until all options to be modified are selected.
If the "↵" key is pressed without entering a number, the option of the subsequent number can be selected.

Enter "E↵" to end option setting. Then, move to the confirmation procedure for HEX file generation (See Section 4.5).

Example: • When modifying the settings of the function option of No. 9

```
PLEASE INPUT EDIT NO.? 9↵
```

• When ending setting

```
PLEASE INPUT EDIT NO.? E↵
```

## *4.4 Selecting Function Options*

Option selection is done interactively. For new settings, set Options 1 to last sequentially; to modify settings, the specified option number may be set directly.

```
*** OPTION  NO.3 ***

--- MULTIPLE KEY ENTRY RESET ---

        COMBINATION     1. Not Use
                        2. Use  K00,K01
                        3. Use  K00,K01,K02
                        4. Use  K00,K01,K02,K03

PLEASE SELECT  NO.(1) ? 2↵

        COMBINATION     2. Use  K00,K01  SELECTED

*** OPTION  NO.4 ***

--- INTERRUPT NOISE REJECTOR ---

        K00-K03         1. Use
                        2. Not Use

PLEASE SELECT NO.(1) ? B↵

*** OPTION  NO.3 ***

--- MULTIPLE KEY ENTRY RESET ---

        COMBINATION     1. Not Use
                        2. Use  K00,K01
                        3. Use  K00,K01,K02
                        4. Use  K00,K01,K02,K03

PLEASE SELECT  NO.(1) ?
```

The selections for each option correspond one to one to the option list. While referring to the contents recorded in the option list, enter the selection number.

In the message that prompts entry, the value in parentheses ( ) indicates the default value in case of new settings, or the previously set value in case of setting modification. This value is set when only the RETURN key "↵" is pressed.

In return, the confirmation is displayed.

When you wish to modify previously set function options in the new setting process, enter "B↵" to return 1 step back to the previous function option setting operation.

When function option setting is completed, move to the confirmation procedure for HEX file generation (See Section 4.5).

## 4.5 HEX File Generation and EPROM Selection

When setting function options setting is completed, the following message is output to ask the operator whether to generate the HEX file.

```
END OF OPTION SETTING.
DO YOU MAKE HEX FILE (Y/N) ? Y↵   ..(1)

*** OPTION EPROM SELECT MENU ***

        1. 27C64
        2. 27C128
        3. 27C256
        4. 27C512

PLEASE SELECT NO.? 2↵             ..(2)

        2. 27C128   SELECTED
```

When debugging the program with evaluation board, HEX file C2XXYYYF.HEX is needed.

*Note* *The EPROM to be mounted on the evaluation board must satisfy the following conditions:*
*EPROM for setting function options:*
*Tacc ≤ 250 ns*
*(Tacc: Access time)*

### (1) DO YOU MAKE HEX FILE (Y/N)?

When debugging the program with evaluation board, HEX file C2XXYYYF.HEX is needed, so enter "Y". If "N" is entered, no HEX files are generated and only document files C2XXYYYF.DOC is generated.

### (2) PLEASE SELECT NO.?

For the option ROM selection menu displayed when "Y" is entered in Step (1), select the EPROM to be used for setting evaluation board options. This menu is not displayed when "N" is entered in Step (1). One EPROM is required for setting function options (27C128 is selected in the above example).

```
MAKING FILE(S) IS COMPLETED.
```

When the above operation is completed, FOG62XX generates files. If no error is committed while setting segment options, the following message is output and the sequence returns to the operation selection menu.

## 4.6 End Procedure

This section explains how to end FOG62XX execution.

```
*** OPERATION SELECT MENU ***

        1. INPUT NEW FILE
        2. EDIT FILE
        3. RETURN TO DOS

PLEASE SELECT NO.? 3↵

A>
```

When a series of operations are complete, the sequence returns to the operation selection menu. Execution of FOG62XX can be ended by selecting "3. RETURN TO DOS" on this menu. If "1. INPUT NEW FILE" or
"2. EDIT FILE" is selected, setting function options can be performed again.

FOG62XX can be forcibly terminated by pressing the "CTRL" and "C" keys together during program execution. (It is possible by pressing "STOP" key depending on the PC used.)

# VI

## SEGMENT OPTION GENERATOR

# SOG62XX

This part mainly explains how to operate the Segment Option Generator SOG62XX for setting the segment options of the S1C62 Family.

# SEGMENT OPTION GENERATOR SOG62XX

## Contents

# 1 DIFFERENCES DEPENDING ON THE MODEL

The segment output specific, display memory capacity and address will vary depending on the model.
Here the explanation will focus on the method of operation. For the optional specifications, we will provide an outline explanation as an example for the case of models with standard segment specifications that are set by the four terminal common output, so you should refer to the "S5U1C62xxxD Manual" for details on each model.
The SOG62XX is not included in the software for models that are not set by the segment option.

# 2 SOG62XX OUTLINE

## 2.1 Outline and Execution Flow

With the 4-bit single-chip S1C62XXX microcomputers, the customer may select the LCD segment options. By modifying the mask patterns of the S1C62XXX according to the selected options, the system can be customized to meet the specifications of the target system.
The SOG62XX Segment Option Generator (hereinafter called SOG62XX) is a software tool for generating data files used to generate mask patterns. From the data file created with SOG62XX, the S1C62XXX mask pattern is automatically generated by a general purpose computer.
The HEX file for the evaluation board (S5U1C62xxxE) segment option ROM is simultaneously generated with the data file. By writing the contents of the HEX file into the EPROM and mounting it on the evaluation board, option functions can be executed on the evaluation board.

The program name of SOG62XX is as follows:

**SOG62XX.EXE**

Figure 2.1.1 shows the SOG62XX execution flow.

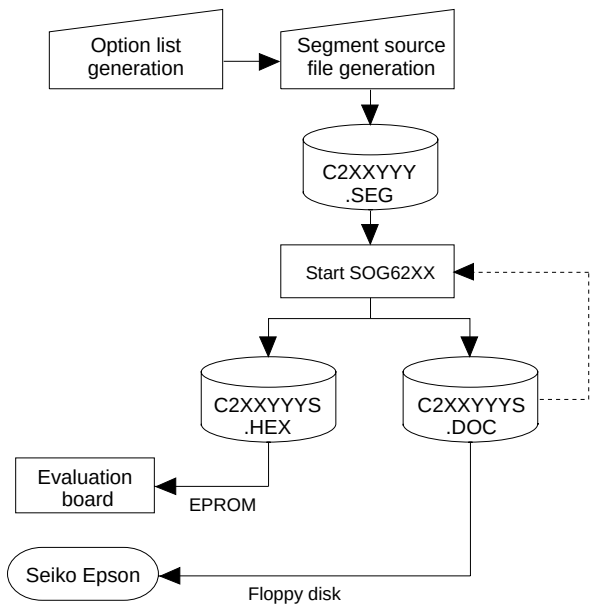



*Fig. 2.1.1 SOG62XX execution flow*

## *2.2 SOG62XX Input/Output Files*

SOG62XX reads a source file containing segment port specification, and output following files.

### ■ Segment option source file (C2XXYYY.SEG)

The specifications of segment ports must be set in the segment source file (input file for SOG62XX). If the segment source file is not generated, SOG62XX stops execution.
Generate the segment source file using an editor such as EDLIN while referencing the option list.

### ■ Segment option document file (C2XXYYYS.DOC)

This is a data file used to generate the mask patterns of the segment decoder and segment output port.

### ■ Segment option HEX file (C2XXYYYS.HEX)

This is a segment option file for evaluation board (Intel hexa format). Evaluation board segment option ROMs are generated by writing this file with the ROM writer.

*Remarks:*

- *File name "YYY" is specified for each customer by Seiko Epson.*
- *Combine the segment option document file (C2XXYYYS.DOC) with the program files (C2XXYYYH.HEX and C2XXYYYL.HEX) and the function option document file (C2XXYYYF.DOC) using the mask data checker (MDC62XX): copy the combined file into another diskette and submit to Seiko Epson.*
- *Set all unused ROM areas to FFH when writing the HEX file into the EPROM. (Refer to "S5U1C62xxxE Manual" for the ROM installation location.)*

# 3 OPTION LIST GENERATION

## 3.1 Example of Option List

The following table shows an example of the option list in case of the four commons. Refer to the "S5U1C62xxxD Manual" for the option list of each model.

*Example of option list*

| TERMINAL NAME | ADDRESS | | | | | | | | | | | | OUTPUT SPECIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | COM0 | | | COM1 | | | COM2 | | | COM3 | | | |
| | H | L | D | H | L | D | H | L | D | H | L | D | |
| SEG0 | | | | | | | | | | | | | SEG output |
| SEG1 | | | | | | | | | | | | | DC output ☐ C ☐ P |
| SEG2 | | | | | | | | | | | | | SEG output |
| SEG3 | | | | | | | | | | | | | DC output ☐ C ☐ P |
| SEG4 | | | | | | | | | | | | | SEG output |
| SEG5 | | | | | | | | | | | | | DC output ☐ C ☐ P |
| : | | | | | | | | | | | | | : : |
| Legend: | <ADDRESS> H: High order address L: Low order address D: Data bit | | | | | | | | | | | | <OUTPUT SPECIFICATION> C: Complementary output P: Pch open drain output |

Multiple specifications are available in segment option item as indicated in the following example. Using "S5UC62xxxD Manual" as reference, select the specifications that meet the target system and check the appropriate box. Be sure to record the specifications for unused ports too, according to the instructions provided.
Furthermore, write the segment memory addresses as well as the selected output specifications.
Create a segment option source file by using the option list as reference.

## 3.2 Segment Ports Output Specifications

For the output specification of the segment output ports (SEG0–SEG*), segment output and DC output can be selected in units of two terminals. When used for liquid crystal panel drives, select segment output; when used as regular output port, select DC output. When DC output is selected, either complementary output or Pch open drain (Nch open drain is set depending on the model used) may further be selected. However, for segment output ports that will not be used, select segment output.

### ■ When segment output is selected

The segment output port has a segment decoder built-in, and the data bit of the optional address in the segment memory area can be allocated to the optional segment.
The segment memory may be allocated only one segment and multiple setting is not possible.
Segment allocation is set to H for high address, to L for low address (0–F), and to D for data bit (0–3) and are recorded in their respective column in the option list. For segment ports that will not be used, write a hyphen ("-") each on the H, L, and D columns.
The allocated segment displays when the bit for this segment memory is set to "1", and goes out when bit is set to "0".

### ■ When DC output is selected

The DC output can be selected in units of two terminals. Also, either complementary output or open drain output is likewise selected in units of two terminals. When the bit for the selected segment memory is set to "1", the segment output port goes high ($V_{DD}$), and goes low ($V_{SS}$) when set to "0".
Segment allocation is the same as when segment output is selected but for the while the segment memory allocated to COM1–COM3 becomes ineffective. Write three hyphens ("---") in the COM1–COM3 columns in the option list.

*Note The configuration of the common terminals (COM0–COM3) may vary depending on the model.*

# 4 SOG62XX OPERATION PROCEDURE

## 4.1 Creating Segment Option Source File

The SOG62XX needs, as an input file, a segment option source file containing the specifications for the segment output ports. Using the editor, generate this source file by referencing the contents of the option list. Use the following file name. For "YYY", enter the string distributed by Seiko Epson.

**C2XXYYY.SEG**

Write the output specifications (SEG output, DC complementary output, or DC open drain output) and the segment memory-SEG ports correspondence data (data that associates segment memory addresses to SEG ports) in the file. Comments may also be written in the file. The description procedure is explained by using a sample segment option source file.

*Note* *In the following examples, there are cases of models where the common output is 4 terminals and the 900H–AFFH is set in the display memory area. You should be aware of the fact that the number of output ports and the display memory address may vary depending on the model.*

```
; C2XXYYY.SEG
; LCD SEGMENT DECODE TABLE
;
;
 0      901     900     932     A20     S       ;1st DIGIT
 1      912     911     910     923     S
 2      913     920     921     922     S
 3      A00     902     930     931     S
 4      AE0     ---     ---     ---     C       ;DC OUTPUT
 5      AF0     ---     ---     ---     C
 :       :       :       :       :      :
```

Comment

Segment memory-SEG ports correspondence data

Output specification data

Comment

### ■ Comment

A statement beginning with a semicolon (";") is considered a comment. Such items as date, summary, and version may be written in such a line.

### ■ Segment memory-SEG ports correspondence data

This data indicates correspondence between segment memory addresses and segment ports. The arrangement is the same as that of the option list, so write the data in the following format while referencing the option list.

```
0_901_900_932_A20
:_:::_:::_:::_:::
```

| | | |
|---|---|---|
| Segment memory data bit (D) | 0–3 | COM3 |
| Segment memory low-order address (L) | 0–F | |
| Segment memory high-order address (H) | 9–A* | |
| Segment memory data bit (D) | 0–3 | COM2 |
| Segment memory low-order address (L) | 0–F | |
| Segment memory high-order address (H) | 9–A* | |
| Segment memory data bit (D) | 0–3 | COM1 |
| Segment memory low-order address (L) | 0–F | |
| Segment memory high-order address (H) | 9–A* | |
| Segment memory data bit (D) | 0–3 | COM0 |
| Segment memory low-order address (L) | 0–F | |
| Segment memory high-order address (H) | 9–A* | |
| SEG port number | | |

*Note* *The high-order address of the segment memory may vary depending on the model.*

- Each SEG port number corresponds to an actual device, so it must be unique. Moreorve, data descriptions in accordance with the following format are required for segments SEG0–SEG25.
- Off areas COM0 to COM3, write three successive "---" (3 hyphens) as data for unused areas. SEG port numbers are needed even if the ports themselves will not be used, so write "---" (3 hyphens) for all areas COM0 to COM3.

  Example: When not using COM2 in SEG8
  ```
  8_981_980_---_A22
  ```

  Example: When not using SEG12
  ```
  12_---_---_---_---
  ```

- When "DC output" is selected, write the segment memory-SEG ports correspondence data for COM0; "---" (hyphens) for COM1 to COM3.

  Example: When outputting SEG20 and SEG21 as DC output
  ```
  20_933_---_---_---
  21_A33_---_---_---
  ```

- Symbol "_" indicates a blank or tab. Be sure to write one or more blanks or a tab between the SEG port number, COM0, COM1, COM2, and COM3.

## ■ Output specification selection data

This data is used to specify whether the SEG port will be used as a segment output port, a DC complementary output port, or a DC open drain output port.
Write data after inserting one or more blanks or a tab after the segment memory-SEG ports correspondence data.

S: Segment output
C: DC complementary output
P: DC Pch open drain output
N: DC Nch open drain output

] Either one is set, depending on the model.

- The SEG port output specifications must be selected in units of two ports, so write the selection data carefully while referencing the option list.

  Example: When outputting SEG22 and SEG23 as DC complementary output
  ```
  22_AE0_---_---_---_C
  23_AF0_---_---_---_C
  ```

- Select "SEG output" for the segment ports that will not be used.

  Example: When not using SEG18
  ```
  18_---_---_---_---_S
  ```

*Note* *Only complementary output is enabled as the DC output of the SEG ports of evaluation board. Therefore, complementary output is enabled even if open drain output is selected. Respond to it by adding external circuits as required.*

Generate the segment option source file according to the formats and restrictions above.

## *4.2 Starting SOG62XX*

To start SOG62XX, enter the following at the DOS command level (state in which a prompt such as A> is displayed):

```
A>SOG62XX_[-H]↵
```

*_ indicates a blank.*
*A parameter enclosed by [ ] can be omitted.*
*↵ indicates the return key.*

When starting SOG62XX through the DMS6200, selects the "SOG62XX.EXE" in the menu screen, and input options necessary.
The current drive must contain the segment option source file (C2XXYYY.SEG).

*-H: Specifies the segment option document file (C2XXYYY.DOC) for input file of SOG62XX.*

When SOG62XX is started, the following message is displayed.

```
        ***  E0C62XX SEGMENT OPTION GENERATOR. --- Ver 3.00  ***

   EEEEEEEEEE   PPPPPPPP        SSSSSSS       OOOOOOOO      NNN     NNN
   EEEEEEEEEE   PPPPPPPPPP     SSS   SSSS    OOO    OOO     NNNN    NNN
   EEE          PPP     PPP   SSS     SSS   OOO      OOO    NNNNN   NNN
   EEE          PPP     PPP    SSS          OOO      OOO    NNNNNN  NNN
   EEEEEEEEEE   PPPPPPPPPP      SSSSSS      OOO      OOO    NNN NNN NNN
   EEEEEEEEEE   PPPPPPPP           SSSS     OOO      OOO    NNN  NNNNNN
   EEE          PPP                SSS     OOO      OOO    NNN   NNNNN
   EEE          PPP           SSS     SSS   OOO      OOO    NNN    NNNN
   EEEEEEEEEE   PPP           SSSS   SSS     OOO    OOO     NNN     NNN
   EEEEEEEEEE   PPP             SSSSSSS       OOOOOOOO      NNN      NN

              (C) COPYRIGHT 1991  SEIKO EPSON CORP.

          SEGMENT OPTION SOURCE FILE NAME IS " C2XXYYY.SEG ".

          THIS SOFTWARE MAKES NEXT FILES.

             C2XXYYYS.HEX  ...  SEGMENT OPTION HEX FILE.
             C2XXYYYS.DOC  ...  SEGMENT OPTION DOCUMENT FILE.

                          STRIKE ANY KEY.
```

For "STRIKE ANY KEY.", press any key to advance the program execution. To suspend execution, press the "CTRL" and "C" keys together: the sequence returns to the DOS command level. (It is possible by pressing "STOP" key depending on the PC used.)

Following the start message, the date currently set in the personal computer is displayed, prompting entry of a new date.

```
   *** E0C62XX USER'S OPTION SETTING. --- Ver 3.00 ***

   CURRENT DATE IS  91/07/19
   PLEASE INPUT NEW DATE  :   91/07/22↵
```

When modifying the date, enter the 2-digit year, month, and day of the month by delimiting them with a slash ("/").
When not modifying the date, press the RETURN key "↵" to continue.

## 4.3 Input File Selection

```
*** SOURCE FILE(S) ***

C2XX0A0        C2XX0B0        C2XX0B1        C2XX0C0              ..(1)

PLEASE INPUT SEGMENT SOURSE FILE NAME? C2XX0A0↲                    ..(2)
PLEASE INPUT USER'S NAME? SEIKO EPSON CORP.↲                       ..(3)
PLEASE INPUT ANY COMMENT
(ONE LINE IS 50 CHR)? TOKYO DESIGN CENTER↲                         ..(4)
                    ? 421-8 HINO HINO-SHI TOKYO 191 JAPAN↲
                    ? ↲
```

### (1) *** SOURCE FILE(S) ***

- ***H option use***

  Will display the segment option source files on the current drive.
  If no source files exists, the following message will be displayed and the program will be terminated.

  ```
  SEGMENT OPTION SOURCE FILE IS NOT FOUND.
  ```

- ***H option not use***

  Will display the segment option document files on the current drive.
  If no document files exists, the following message will be displayed and the program will be terminated.

  ```
  SEGMENT OPTION DOCUMENT FILE IS NOT FOUND.
  ```

### (2) PLEASE INPUT SEGMENT SOURCE FILE NAME?

- ***H option use***

  Enter the segment option source file name. Do not enter the extended part of the file name. If the specified file name is not found in the current drive, an error message like the one below is output, prompting entry of another file name:

  Example:
  ```
  PLEASE INPUT SEGMENT SOURCE FILE NAME? C2XX0N0↲
  SEGMENT OPTION SOURCE FILE IS NOT FOUND.
  ```

- ***H option not use***

  Enter the segment option document file name. Do not enter the extended part of the file name. If the specified file name is not found in the current drive, an error message like the one below is output, prompting entry of another file name:

  Example:
  ```
  PLEASE INPUT SEGMENT DOCUMENT FILE NAME? C2XX0N0↲
  SEGMENT OPTION DOCUMENT FILE IS NOT FOUND.
  ```

### (3) PLEASE INPUT USER'S NAME?

Enter the customer's company name.

### (4) PLEASE INPUT ANY COMMENT

Enter any comment. Up to 50 characters may be entered in one line. If 51 or more characters are entered in one line, they are ignored. Up to 10 comment lines may be entered. To end entry of comments, press the RETURN key "↲". Include the following in comment lines:

- Company, department, division, and section names
- Company address, phone number, and FAX number
- Other information, including technical information

When the above operations are complete, move to the confirmation procedure for HEX file generation.

## 4.4 HEX File Generation and EPROM Selection

When input file selection is completed, the following message is output to ask the operator whether to generate the HEX file.

```
        END OF OPTION SETTING.
        DO YOU MAKE HEX FILE (Y/N) ? Y↵    ..(1)

        *** OPTION EPROM SELECT MENU ***

                1. 27C64
                2. 27C128
                3. 27C256
                4. 27C512

        PLEASE SELECT NO.? 2↵              ..(2)

                2. 27C128   SELECTED
```

### (1) DO YOU MAKE HEX FILE (Y/N)?

When debugging the program with evaluation board, HEX file C2XXYYYS.HEX is needed, so enter "Y". If "N" is entered, no HEX file is generated and only document file C2XXYYYS.DOC is generated. However, when H option is used, HEX file is generated without any conditions. Therefore, this menu is not displayed.

### (2) PLEASE SELECT NO.?

For the option ROM selection menu displayed when "Y" is entered in Step (1), select the EPROM to be used for setting evaluation board options. This menu is not displayed when "N" is entered in Step (1). "27C128" is selected in the above example.

When the above operation is completed, SOG62XX generates files. If no error is committed while setting segment options, the following message is output and the SOG62XX program will be terminated.

```
        MAKING FILE IS COMPLETED.
```

*Note* *The EPROM to be mounted on the evaluation board must satisfy the following conditions: EPROM for setting segment option:Tacc ≤ 170 ns (Tacc: Access time)*

## 4.5 End Procedure

When a series of operations are complete, the SOG62XX program will be terminated.

SOG62XX can be forcibly terminated by pressing the "CTRL" and "C" keys together during program execution. (It is possible by pressing "STOP" key depending on the PC used.)

# 5 ERROR MESSAGES

If an error is detected in the segment option source file, an error message is displayed. In this case, the segment option HEX file is not generated, and the segment option document file consisting of the segment option source file and an error message is generated.

*Note* *In the following examples, there are cases of models where the common output is 4 terminals, the segment output is 26 terminals and the 900H–AFFH is set in the display memory area. You should be aware of the fact that the number of output ports and the display memory address may vary depending on the model.*

```
N 12   66          9B0       9B1       9B2       9B3       S
S 16   15          9F0MSD    9F1       9F2       9F3       S
D 20   19          A30       A31       A32       A31       S
N 22   42          A50       A51       A52       A53       S
D 23   22          A60       A61       A31       A31       S
R 25   24          A80       881       A82       A83       S

Duplication is  SEG NO. 19  COM NO. 3
Duplication is  SEG NO. 22  COM NO. 2
Duplication is  SEG NO. 22  COM NO. 3

7 ERROR(S)

STRIKE ANY KEY.

MAKING SEGMENT OPTION FILES IS NOT COMPLETED BY SOURCE FILE ERROR-(S).
```

If one or more errors are detected, error symbols are output in column 0 and the source lists containing the errors are output in subsequent columns. The following four error symbols are used for SOG62XX:

S: Syntax error
N: Segment number selection error
R: RAM address selection error
D: Duplication error

The priority order is S, N, R, and D.

Each type of error is explained here.

### S: Syntax error

This type of error occurs when the data was written in an invalid format. Correct the segment option source file format.

Example:
```
S 16   15      9F0MSD   9F1      9F2      9F3      S
                ↑
```
This format is invalid

### N: Segment number selection error

This type of error occurs when a segment number outside the specificable range is specified. Correct the segment option source file so that all segment numbers are in the specificable range.

Example:
```
N 12   66      9B0      9B1      9B2      9B3      S
N 22   42      A50      A51      A52      A53      S
       ↑
```
These values exceeds the range

### R: RAM address selection error

This type of error occurs when the segment memory address or data bit outside the specificable range. Correct the segment option source file so that all addresses are in the specificable range and all data bits are 0 to 3.

Example:
```
R 25   24      A80      881      A82      A83      S
                ↑
```
This value exceeds the range

### D: Duplication error

This type of error occurs when the same data (SEG port No., segment memory address, or data bit) is specified more than once. Correct the segment option source file so that each data item is unique in the description.

Example:
```
D 20   19     A30     A31     A32     A31     S
D 23   22     A60     A61     A31     A31     S      "A31" is used more then once
Duplication is SEG NO. 19 COM NO. 3
Duplication is SEG NO. 22 COM NO. 3
```

Message "Duplication is ..." is output only for the second and subsequent duplicated data items.

In some cases, the following error message is output.

### Out Port Set Error

This error occurs when the output specifications were not set in units of two ports. Correct the segment option source file to satisfy this condition.

Example: `Segment No. 18 - 19 Out Port Set Error`

This error is not checked when one of the above four errors (S, N, R, or D) is detected. Therefore, this error may occur after the above error are corrected.

If an error occurs, the displayed message can be checked by referencing the segment option document file. Correct the segment option source file by comparing it with the option list, then rerun the program.
The following is an example of the segment option document file when some errors occurred.

```
 LINE  SOURCE STATEMENT

    1   0        900     901     902     903     S
    2   1        910     911     912     913     S
    3   2        920     921     922     923     S
    4   3        930     931     932     933     S
    5   4        940     941     942     943     S
    6   5        950     951     952     953     S
    7   6        960     961     962     963     S
    8   7        970     971     972     973     S
    9   8        980     981     982     983     S
   10   9        990     991     992     993     S
   11   10       9A0     9A1     9A2     9A3     S
N  12   66       9B0     9B1     9B2     9B3     S
   13   12       9C0     9C1     9C2     9C3     S
   14   13       9D0     9D1     9D2     9D3     S
   15   14       9E0     9E1     9E2     9E3     S
S  16   15       9F0MSD  9F1     9F2     9F3     S
   17   16       A00     A01     A02     A03     S
   18   17       A10     A11     A12     A13     S
   19   18       A20     A21     A22     A23     S
D  20   19       A30     A31     A32     A31     S
   21   20       A40     A41     A42     A43     S
N  22   42       A50     A51     A52     A53     S
D  23   22       A60     A61     A31     A31     S
   24   23       A70     A71     A72     A73     S
R  25   24       A80     881     A82     A83     S
   26   25       A90     A91     A92     A93     S

  S --- Syntax Error
  N --- Segment No. Select Error
  R --- RAM Address Select Error
  D --- Duplication Error

Duplication is   SEG NO. 19  COM NO. 3
Duplication is   SEG NO. 22  COM NO. 3
```

# VII

## EVALUATION BOARD

# S5U1C62xxxE

This part explains the function of the Evaluation Board S5U1C62xxxE, a debugging tool for the S1C62XXX, and the operation of the evaluation board.

# EVALUATION BOARD S5U1C62xxxE

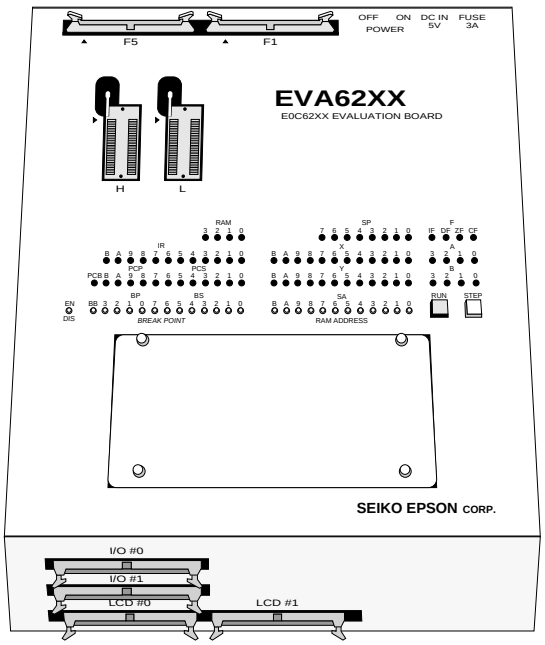
## Contents

# 1 DIFFERENCES DEPENDING ON THE MODEL

The S5U1C62xxxE has the same functions as the actual IC (S1C62XXX). Although the method of operation and other functions are the same, the terminal layout of the I/O and LCD connectors and the input/output signal specifications are different. The layout in the top panel is also different.
Refer to the "S5U1C62xxxE Manual" included with the hardware for details on each model.

# 2 S5U1C62XXXE OUTLINE

The S5U1C62xxxE is a debugging tool for the S1C62XXX, with various functions such as single step and program break.
Almost the same functions that the S1C62XXX CPU has can be implemented by writing application program and option data created by the option generator into EPROM, and installing it in the S5U1C62xxxE.
Debugging and CPU monitoring can be done using the S5U1C62xxxE operation switches and LED indicators; therefore, debugging is possible with the S5U1C62xxxE alone.
In addition, the S5U1C62xxxE can interface with the ICE (S5U1C62000H) in-circuit emulator, and so perform a higher level of debugging.




*S5U1C62xxxE*

∗ The name 'EVA62XX' on the development tool is the old name of the product.

# 3 PRECAUTIONS

Take the following precautions when using the S5U1C62xxxE:

## 3.1 Precautions for Operation

- Turn the power of all equipment off before connecting or disconnecting cables.
- To turn the POWER switch of the S5U1C62xxxE off, then on again, wait for at least 10 seconds after turning off before turning on.
- When ROMs are inserted into the L and H ROM sockets, lock the lever securely by positioning it horizontally. After the ROMs have been removed from the sockets, lock the lever at the same position above. If the lever is left upright, poor contact may result.
- Confirm that the ROMs have been installed correctly, then operate the S5U1C62xxxE.
- If the S5U1C62xxxE does not operate normally, perform the operation test. (See "S5U1C62xxxE Manual".)

## 3.2 Differences from Actual IC

There are some differences in functions between the S5U1C62xxxE and the actual IC.

### ■ I/O differences

The response time has been changed by the differences in logic level (5 V for the S5U1C62xxxE), output drive capability, and pull-down / up resistance. When creating key scan routines, especially, pay attention to the response time.

### ■ LCD differences

- The LCD contrast is adjusted by the VADJ control. However, the contrast level of each actual IC is fixed, so it cannot be adjusted.
- No Pch / Nch open drain option can be selected.
- The output drive capability is different.

### ■ Power-on sequence differences

The S5U1C62xxxE performs configuration and determines the internal state when the power is switched on. Then, it works as the IC does. Therefore, the I / O state of the S5U1C62xxxE is unstable until configuration has completed. This affects the power-on reset time.

### ■ Function differences

The oscillation start and stop times are different from those of the IC.
Because the logic level of S5U1C62xxxE is higher than it of actual IC.

Functions may differ depending on the model, so you should refer to the "S5U1C62xxxE Manual" for other differences.

# 4 NAMES AND FUNCTIONS OF PARTS

This section describes the names and functions of the parts of the S5U1C62xxxE.

## 4.1 Basic Functions

The S5U1C62xxxE has the following basic functions:

- **Program execution (Run function)**
  Install the EPROM containing the application program and execute the program.
- **Single-step program operation (Single-step function)**
  Programs may be run instruction by instruction to check the internal state of the CPU as it changes with each instruction.
- **Program execution suspension at a given address (Break function)**
  A breakpoint may be set at an address at which it is desired to suspend program execution. After execution has stopped at the breakpoint, it can be restarted with the program run function.
- **Displaying program addresses and instruction codes during a break**
  Program addresses and instruction codes may be displayed on the LED indicators.
- **Displaying the contents of RAM, registers, and flags during a break**
  The contents of RAM, the A, B, X, and Y registers, the stack pointers, and the flags may be displayed on the LED indicators during a break.
- **Interface with ICE**
  The S5U1C62xxxE can interface with the ICE so that a higher level debugging environment may be established.
- **Setting hardware options by installing function option and segment option ROMs**
  Hardware options, i.e., I/O ports and segments, can be specified by writing option data for the functions created by the function option generator and the segment option created by the segment option generator into EPROM, and installing the EPROM.

## 4.2 Operating Panel (Top view)

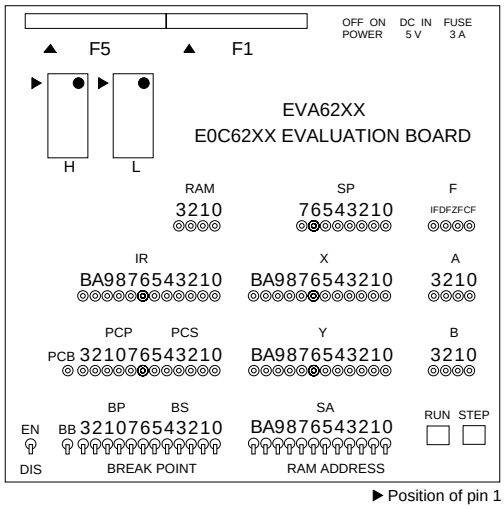



*Fig. 4.2.1 Operating panel*

- **Switches and keys**

  - EN/DIS switch
    This switch enables or disables the setting of breakpoints. When the switch is in the EN (Enable) position, the setting of breakpoints is enabled. When it is in the DIS (Disable) position, the setting of breakpoints is disabled. Normally, set the switch to the DIS position.

- BREAK POINT switches (BB, BP, BS)
  These switches set a breakpoint address at which program execution stops. BB, BP, and BS are switches that set the bank, page, and step, respectively, of the breakpoint address. When a switch is in the upper position, it represents "1"; when it is in the lower position, it represents "0".
  The breakpoint address set with the BREAK POINT switches is valid when the EN / DIS switch is in the EN position. When the set address matches the current address of the program being executed, the program breaks, i.e., it stops immediately before executing the instruction at the current address. This function does not work when the EN / DIS switch is in the DIS position.
- RAM ADDRESS switches (SA)
  These switches are used to set RAM addresses and to check the contents of RAM after a program break. When a switch is in the upper position, it represents "1"; when it is in the lower position, it represents "0". The contents of the address set with these switches are displayed on the RAM display LEDs.
- RUN key
  This key restarts the program after a break. When it is pressed, the program continues, starting with the instruction at the break address.
- STEP key
  When this key is pressed, the program breaks immediately. If the key is pressed during a break, the instruction step at the break address is executed, and the program breaks again. Thus, the program can be executed step by step.

## ■ LEDs

The internal state of the CPU is indicated by the LEDs. An LED lit indicates "1"; an LED not lit indicates "0".

- RAM (3210) The contents of the RAM address, which are fixed by the RAM ADDRESS switch, are displayed.
- IR (BA9876543210) The instruction at the current address is displayed. If the program has stopped at a breakpoint, the instruction is displayed before execution.
- PCB The bank address is displayed.
- PCP (3210) The page address is displayed.
- PCS (76543210) The step address is displayed.
- SP (76543210) The value of the stack pointer is displayed.
- X (BA9876543210) The contents of the X index register are displayed.
- Y (BA9876543210) The contents of the Y index register are displayed.
- F/IF The state of the interrupt flag is displayed.
- F/DF The state of the decimal flag is displayed.
- F/ZF The state of the zero flag is displayed.
- F/CF The state of the carry flag is displayed.
- A (3210) The contents of the A register are displayed.
- B (3210) The contents of the B register are displayed.

## ■ ROM sockets

- L (low) and H (high)
  These are IC sockets for target program ROMs. Insert the ROM (L.HEX) containing the 8 low-order bits (I7 to I0) of the machine code into the L socket, and the ROM (H.HEX) containing the 4 high-order bits (IB to I8) into the H socket. Insert the diagnostic ROM into a socket when an operation test is performed.

## ■ Connectors

- F1 and F5 Connectors for the ICE interface cable.

## 4.3 Under Top Cover

The layout and content within the top cover will vary depending on the model.
The below content is laid out here in a basic manner. Refer to the "S5U1C62xxxE Manual" for details.

- RESET switch
  This switch resets the CPU and starts the target program from page 01H, step 00H.
- VADJ
  This is the control for adjusting the LCD contrast.
  (Refer to the "S5U1C62xxxE Manual".)
- VSVD
  This is the control for varying the power supply voltage in simulation to check SVD operation.
  (Refer to the "S5U1C62xxxE Manual".)
  This control is not present in models that do not have the SVD function.
- DONE
  This LED lights when the S5U1C62xxxE has completed configuration at power-on and is ready for debugging. If this LED is not lit several seconds after power-on, switch the power off and then on again.
- F.HEX (ROM sockets)
  This is the IC socket into which the ROM (F.HEX) is inserted. This ROM includes the function options generated by the function option generator (FOG62XX).
- LED and CHK pin
  LEDs that display the value ("1" or "0") of the special I/O registers and a terminals for confirmation by oscilloscope or a like device have been provided.

## 4.4 Front Panel

There are several connectors on the front panel for connecting the S5U1C62xxxE to the target system.

- I/O #0, I/O #1
  Connector for the I/O cable. The I/O cable is used to connect the S5U1C62xxxE to the target system.
- LCD #0, LCD #1
  Connector for the LCD cable. The LCD cable is used to connect the S5U1C62xxxE to the target system.

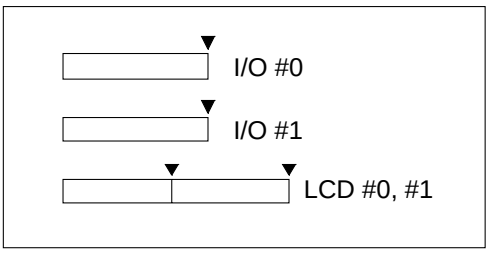



*Fig. 4.4.1 Front panel*

## 4.5 Rear Panel

The external power input section is on the rear panel.

- POWER switch (on/off)
  This is a switch to turn on or off the external power supply to S5U1C62xxxE. (Please turn off the POWER switch when ICE is connected.)
- FUSE
  This is 3 A of the 3 A tubular fuse for external power supply, and is blown off by current of 3 A or more.
- DC IN 5 V
  This is a connector with external power supply source. The external power supply should be in direct current of 5 V for 3 A or more.

*Note: Be sure to disconnect external power source before connection with ICE, because power is supplied from ICE when you connect S5U1C62xxxE to ICE.*

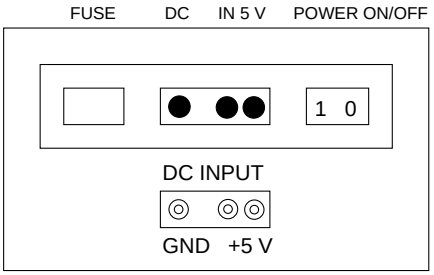



*Fig. 4.5.1 Rear panel*

## 4.6 Under Bottom Cover

- ROM sockets
  This is the IC sockets into which the ROM is inserted. These ROMs (S.HEX) include the assignment of LCD segments generated by the segment option generator (SOG62XX). The ▶ mark indicates the position of pin 1. Insert the same ROMs (two) into the sockets.

  This socket is not present in models that do not have the segment option.

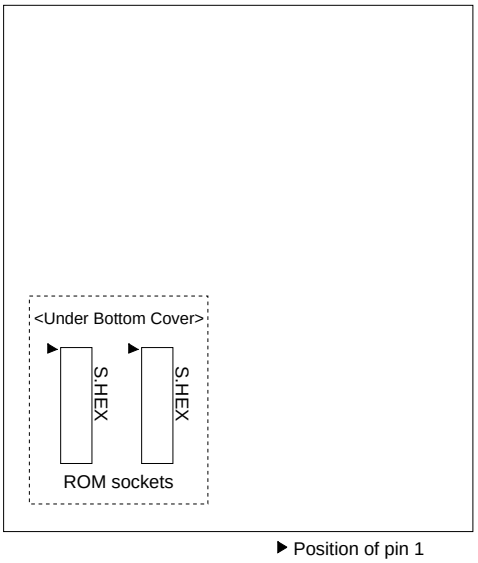



*Fig. 4.6.1 Under bottom cover*

# 5 CABLE CONNECTION

This section describes how to connect the power cable to the S5U1C62xxxE, and the S5U1C62xxxE to the ICE and the target system.

*Note: Turn the power of all equipment off before connecting or disconnecting cables.*

## 5.1 Connection to ICE (S5U1C62000H)

The S5U1C62xxxE is connected to the ICE by connecting the two interface cables (F1 and F5). Use S5U1C62xxxE connectors F1 and F5 with the projections facing outwards. Use ICE connectors F1 and F5 with the projections facing inwards (cable side).
Figures 5.1.1 and 5.1.2 show the external view and connection diagram of the ICE interface cable.

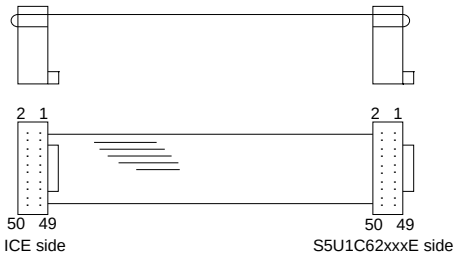



*Fig. 5.1.1 External view of the ICE interface cable*

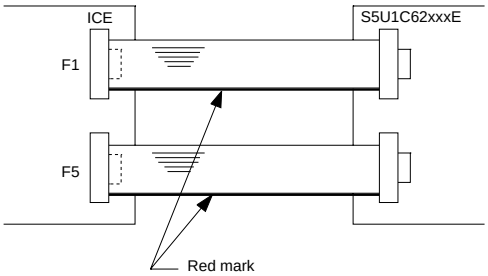



*Fig. 5.1.2 Connection diagram*

*Note: The S5U1C62xxxE has an external power input connector for +5 V ($V_{DD}$) and GND ($V_{SS}$). Leave these connectors unconnected when the S5U1C62xxxE is connected to the ICE.*

## 5.2 Power Cable Connection

When using the S5U1C62xxxE on its own, it must be supplied with power (5 V DC, 3 A or more) from an external source through the power cable.
When the S5U1C62xxxE is connected to the ICE, power is supplied by the ICE; therefore, the power cable is not necessary. Disconnect the power cable if it is already connected.
Figure 5.2.1 shows the connection of the power cable pins.

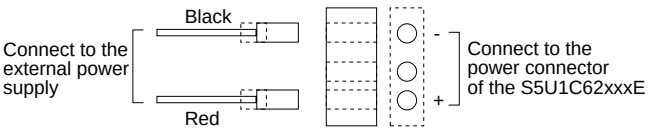



*Fig. 5.2.1 Connection of power cable pins*

## 5.3 Connection to Target System

The I/O #0, I/O #1, LCD #0 and LCD #1 connectors are used to connect the S5U1C62xxxE to the target system.
The signals output from the LCD #0 and LCD #1 connectors are the same as those of the actual IC at the function level. Therefore, the S5U1C62xxxE may be connected to the LCD of the target system without any changes. The LCD contrast (LCD drive voltage) is adjusted by the VADJ control.
Refer to the "S5U1C62xxxE Manual" for the configuration and pins of the connectors.

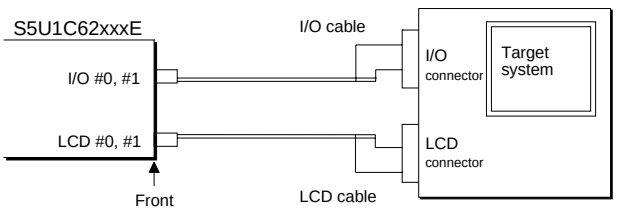



*Fig. 5.3.1 Connection of target system*

# 6 OPERATION METHOD OF S5U1C62XXXE

## 6.1 Preparation

This section describes the common preparation work necessary when the S5U1C62xxxE is used by itself and when it is connected to the ICE. Connection method, refer to Chapter 5, "CABLE CONNECTION". Check the S5U1C62xxxE operation by mounting the supplied diagnostic ROMs as instructed in the "S5U1C62xxxE Manual". It is recommended that this test be performed periodically.
Before doing the following, be sure to turn the POWER switch of the S5U1C62xxxE off.

### 6.1.1 Creation of target system

Mount the LCD panel, keys, and switches on the board to build a target system. Use the I/O connectors and LCD connectors supplied with the S5U1C62xxxE to connect the S5U1C62xxxE to the target system. (For the pin layout of each connector, see the "S5U1C62xxxE Manual".)

*Note: There is some difference in specifications between the S5U1C62xxxE and the actual CPU. Refer to Section 2.2 in the "S5U1C62xxxE Manual", "Differences from Actual IC" when building a target system.*

### 6.1.2 Creation and installation of ROMs

Create the program ROMs, function option ROM and segment option ROMs, and insert them into the sockets of the S5U1C62xxxE. When the S5U1C62xxxE is delivered, the function option ROM and segment option ROMs for a diagnostic program are already installed. Replace them with the created ROMs.

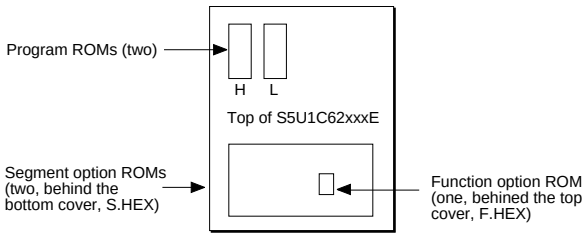



*Fig. 6.1.2.1 Installation of ROMs*

- Program ROMs (two)
  The program ROMs contain the application program machine code. Write the HEX files output by the ASM62XX cross-assembler into EPROMs to create program ROMs. Since two HEX files containing the high-order section (C2XXYYYH.HEX) and the low-order section (C2XXYYYL.HEX) of the machine code are output, two ROMs are created. Insert H.HEX into socket H and L.HEX into socket L on the top panel. These ROMs are not necessary when connecting the S5U1C62xxxE to the ICE.

- Function option ROM (one)
  The function option ROM is used to specify function options, such as I/O ports. Create the option ROM from the function option HEX file (C2XXYYYF.HEX) output by the function option generator, and insert it into the ROM1 socket (F.HEX) in the top cover.

- Segment option ROMs (two) ...Only for the models that have the segment option.
  The segment option ROMs are used to specify segment output ports. Create two segment ROMs (with the same contents) from the segment option HEX file (C2XXYYYS.HEX) output by the segment option generator, and insert them into two S.HEX sockets in the bottom cover.

- EPROM specifications
  Use EPROMs with the following specifications:

| | | |
|---|---|---|
| Program ROM: | 27C64 to 27C512 | (250 ns or less access time) |
| Function option ROM: | 27C64 to 27C512 | (250 ns or less access time) |
| Segment option ROM: | 27C64 to 27C512 | (170 ns or less access time) |

## 6.2 Independent Use of S5U1C62xxxE

This section describes operation when using the S5U1C62xxxE by itself.
The S5U1C62xxxE may be used independently by connecting a power supply to it. Use a 5 V DC regulator (more than 3 A) as an external power supply. Connect it with the correct polarity (+ and -).
(Refer to Section 5.2, "Power Cable Connection".)

### 6.2.1 Power on/off

Before turning the POWER switch of the S5U1C62xxxE on, confirm the following:

(1) The power cable is connected correctly.
(2) The target system is connected correctly.
(3) The ROMs have been installed correctly.

After confirming the above items, turn the POWER switch of the S5U1C62xxxE on using the following procedure:

(1) Turn the regulator on. If the regulator is of the variable-voltage type, set the output voltage to 5 V.
(2) Turn the POWER switch of the S5U1C62xxxE on.

*Note: To turn the POWER switch of the S5U1C62xxxE off, then on, turn it off, wait for 10 seconds or more, and then turn it on.*

After the POWER switch of the S5U1C62xxxE has been turned on, the DONE LED (green) on the top cover lights after several seconds to indicate that debugging may proceed. If the DONE LED is still off 10 seconds or more after the POWER switch has been turned on, do the following:

(1) Turn the POWER switch of the S5U1C62xxxE off.
(2) Confirm that the ROMs have been installed properly, and the cables connected properly.
(3) Check the fuse.
(4) Turn the POWER switch of the S5U1C62xxxE on.

If the DONE LED still does not light, do a self-diagnosis.
For the self-diagnosis method, refer to the "S5U1C62xxxE Manual".

### 6.2.2 Debugging

When the S5U1C62xxxE is used alone, it provides the following debugging functions. The method of operation is given below.

- Program free run
  When the RESET switch (on the top cover) is pressed, the S5U1C62xxxE enters the program run state, and executes the application program from page 1, step 0. Before pressing the RESET switch after the power to the S5U1C62xxxE has been switched on, make sure that the DONE LED is lit.

- Program break
  The program may be stopped at the address set by the BREAK POINT switches. This function is valid when the EN / DIS switch is in the EN position. The program stops at the program address where the breakpoint is set. It stops before the instruction at the breakpoint is executed. The program may be stopped by pressing the STEP key.
  When the program is stopped, the LED indicators for the internal state of the CPU show the current state. So debug by checking this state against the program.
  To restart the program after a break, set the next breakpoint, and press the RUN key.
  The single-step operation (described below) can be performed by pressing the STEP key instead of the RUN key.

- Single step
  By pressing the STEP key after a program break, the one instruction at the current address can be executed, and the program stopped at the next address (program break). Using this function, the program run state can be confirmed.

For the other functions, refer to the "S5U1C62xxxE Manual".

## 6.3 Operation When ICE (S5U1C62000H) is Connected

This section explains the operation and use of the S5U1C62xxxE when it is connected to the ICE.
Set up the S5U1C62xxxE as follows when it is connected to the ICE:

(1) Do not connect the power supply.
(2) Keep on turning the POWER switch off.
(3) Set all the switches on the operation panel to their lower positions.

### 6.3.1 Power on/off

Power to the S5U1C62xxxE is supplied by the ICE, and the power is switched on and off by pressing the POWER switch of the ICE. Keep the POWER switch of the S5U1C62xxxE off.

*Note: To turn the POWER switch of the ICE off, then on, turn it off, wait for 10 seconds or more, and then turn it on.*

After the POWER switch of the ICE has been turned on, the DONE LED (green) on the top cover of the S5U1C62xxxE lights after several seconds to indicate that debugging may proceed. If the DONE LED is still off 10 seconds or more after the POWER switch has been turned on, do the following:

(1) Turn the POWER switch of the ICE off.
(2) Confirm that the circuit breaker of the ICE is on.
(3) Confirm that the ROMs have been installed properly and the cables connected properly.
(4) Turn the POWER switch of the ICE on.

If the DONE LED still does not light, do a self-diagnosis.
For the self-diagnosis method, refer to the "S5U1C62xxxE Manual".

### 6.3.2 Debugging

Debugging is done with the host computer, and the S5U1C62xxxE is controlled by the ICE. For the method of operation, refer to Part VIII, "ICE Control Software ICS62XX".
The switches except the reset switch and LEDs are invalid. Do not operate the switches of the S5U1C62xxxE side. The target program ROM is invalid when the ROM is installed.

# 7 OPERATING TEST

Self-diagnosis of the S5U1C62xxxE can be performed with the following operating tests. To perform these tests, the function option ROM, two segment ROMs and two program ROMs (supplied) are required. If these ROMs have not been installed, insert them into the sockets. To use the S5U1C62xxxE independently, connect the external power supply (5 V DC, 3 A).

Refer to the "S5U1C62xxxE Manual" for details of the operating test.

# VIII

## ICE CONTROL SOFTWARE

# ICS62XX

This part mainly explains the function of S5U1C62000H, a software development support system for the S1C62XXX 4-bit Single Chip Microcomputer, and the operation of ICS62XX, its ICE control software.

# ICE CONTROL SOFTWARE ICS62XX

## Contents

# 1 DIFFERENCES DEPENDING ON THE MODEL

Be sure to pay close attention to the following points, since the memory capacity will vary with the different models of the S1C62 Family, due to program preparation.
The limiting items for each model are indicated in the "S5U1C62xxxD Manual".

## ■ ROM area

The ROM capacity will vary depending on the model.
ICE command specifications that exceed the final ROM address will be errors.

## ■ RAM area

The RAM capacity and area used will vary depending on the model.
ICE command specifications that exceed the final RAM address and specifications for unused area will be errors.

## ■ Undefined code

In the S1C62 Family, the instruction set is not different from model to model. However, you may not be able to use instructions such as the SLP instruction and those that access the page section (XP and YP) of the index register depending on the RAM content. When specified it results in an error.

## ■ OPTLD command

The OPTLD command is the command that loads such things as melody HEX files and the models where it can be used are limited.

# 2 S5U1C62000H SPECIFICATIONS

## 2.1 Features

The ICE (S5U1C62000H) is a microcomputer software development support tool that increases the efficiency of software development for the S1C62 Family of 4-bit single chip microcomputers.
The ICE and the S1C62 Family evaluation board (S5U1C62xxxE), when used in combination, provide an exceptionally powerful hardware and software development support environment.
The following flow chart shows the creation sequence of the single chip microcomputer system from development through mass production.

Use of the ICE and evaluation board can greatly shorten the development process time required for debugging and system evaluation procedures.

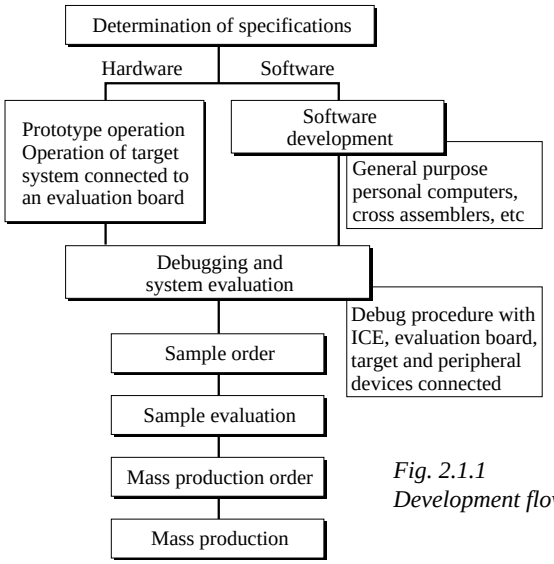



*Fig. 2.1.1 Development flow*

### 2.1.1 Description

A description of the ICE follows.

(1) The ICE operates by connecting to a general purpose personal computer (IBM PC / XT, PC / AT). The debugging environment is constructed by the user's personal computer acting as the host system.
(2) High-performance emulation commands are provided. A variety of commands are supplied, such as a register value implemented break function, on-the-fly data display, history display, and other high-level functions.
(3) The ICE is equipped with a special power supply. This power source supplies $V_{DD}$ to the evaluation board, making additional power supply from the user side unnecessary.
(4) The ICE can also be used to analyze hardware. Hardware debugging is supported through the SYNC and HALT terminals.

### 2.1.2 Software configuration

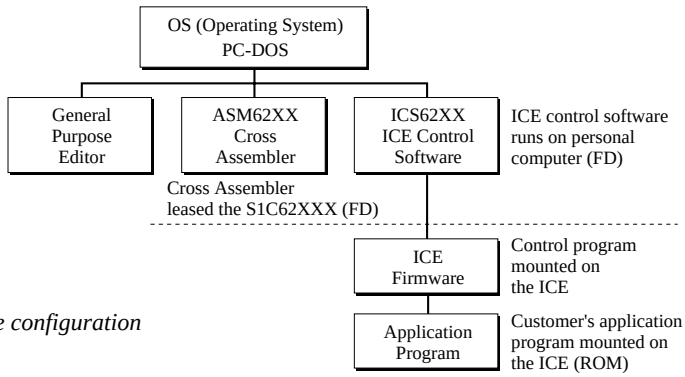



*Fig. 2.1.2.1 Software configuration*

### *2.1.3 Function table*

Table 2.1.3.1 shows the functions supported by the ICE (S5U1C62000H).

*Table 2.1.3.1 ICE (S5U1C62000H) functions*

| Item number | Item | Brief description of function | Comments |
|---|---|---|---|
| 1 | Real-time break | The target program is interrupted under optional conditions<br>(1) Break by program counter (PC)<br>(2) RAM address, data, R/W break<br>(3) Break by register value<br>(4) Break via a combination of items (1)–(3) (AND, OR)<br>(5) Forced break by RESET or BREAK switch settings<br>(6) Forced break by host system Escape key input | |
| 2 | History | Evaluation board CPU data collection during emulation<br>(1) Collection of PC, instruction code, RAM R/W, or CPU register values<br>(2) Approx. 2048 instruction bus data collections<br>(3) Collects information up to the hit of break condition, or before or after the hit<br>(4) Collects history information within the specified program area<br>(5) Searches for history information | |
| 3 | Real-time execution | Target program is run in real time at frequencies up to 4 MHz | |
| 4 | Real-time measurement | Emulation run in real time (up to approx. 425 msec) or step number count | |
| 5 | Target memory referenced or modified | (1) ICE packaged target program memory is referenced, modified, or dumped<br>(2) Target program memory-mapped I/O is referenced or modified<br>(3) Internal CPU registers are referenced or modified | |
| 6 | Trace | Target program is executed step by step and register contents are displayed | |
| 7 | Assemble/ Disassemble | Mnemonic input is converted to machine language and stored in program memory; contents of memory are disassembled | |
| 8 | FD loaded, saved or verified | (1) Data from FD is loaded to the program or verified<br>(2) Program data is saved to FD<br>(3) ICE interim results are loaded or saved to FD<br>(4) Data from FD memory is loaded, saved or verified | |
| 9 | ROM read or verify | Program is loaded to program memory from the ICE ROM socket and verified | |
| 10 | Execution supervision | During G command execution, the program counter and halt state are displayed | |
| 11 | Coverage | Acquire coverage information | |
| 12 | Other | (1) Printer start and stop<br>(2) ICE command display<br>(3) Evaluation board CPU reset<br>(4) Evaluation board CPU status on LED display<br>(5) Execution with SYNC pulse output at breakpoint, but without break<br>(6) 2764 to 27512 EPROM (target) support<br>(7) ICE hardware check | |

### *2.1.4 Function-differentiated command list*

Tables 2.1.4.1(a) and (b) show the function-differentiated command list for the ICE.

*Table 2.1.4.1(a) Function-differentiated command list*

| Item number | Function | Command configuration | Description of operation | Reference page |
|---|---|---|---|---|
| 1 | Assemble | #A,a ↵ | Assemble command mnemonic code and store at address "a" | VIII-38 |
| 2 | Disassemble | #L,a1,a2 ↵ | Contents of addresses a1 to a2 are disassembled and displayed | VIII-20 |
| 3 | Dump | #DP,a1,a2 ↵ | Contents of program area a1 to a2 are displayed | VIII-22 |
| | | #DD,a1,a2 ↵ | Content of data area a1 to a2 are displayed | VIII-24 |
| 4 | Fill | #FP,a1,a2,d ↵ | Data d is set in addresses a1 to a2 (program area) | VIII-40 |
| | | #FD,a1,a2,d ↵ | Data d is set in addresses a1 to a2 (data area) | VIII-41 |
| 5 | Set Run Mode | #G,a ↵ | Program is executed from the "a" address | VIII-60 |
| | | #TIM ↵ | Execution time and step counter selection | VIII-81 |
| | | #OTF ↵ | On-the-fly display selection | VIII-82 |
| 6 | Trace | #T,a,n ↵ | Executes program while displaying results of step instruction from "a" address | VIII-63 |
| | | #U,a,n ↵ | Displays only the final step of #T,a,n | VIII-65 |
| 7 | Break | #BA,a ↵<br>#BAR,a ↵ | Sets Break at program address "a"<br>Breakpoint is canceled | VIII-52 |
| | | #BD ↵<br>#BDR ↵ | Break condition is set for data RAM<br>Breakpoint is canceled | VIII-53 |
| | | #BR ↵<br>#BRR ↵ | Break condition is set for evaluation board CPU internal registers<br>Breakpoint is canceled | VIII-54 |
| | | #BM ↵<br><br>#BMR ↵ | Combined break conditions set for program data RAM address and registers<br>Cancel combined break conditions for program data ROM address and registers | VIII-56 |
| | | #BRES ↵ | All break conditions canceled | VIII-59 |
| | | #BC ↵ | Break condition displayed | VIII-58 |
| | | #BE ↵ | Enter break enable mode | VIII-66 |
| | | #BSYN ↵ | Enter break disable mode | VIII-66 |
| | | #BT ↵ | Set break stop/trace modes | VIII-67 |
| | | #BRKSEL,REM ↵ | Set BA condition clear/remain modes | VIII-68 |
| 8 | Move | #MP,a1,a2,a3 ↵ | Contents of program area addresses a1 to a2 are moved to addresses a3 and after | VIII-42 |
| | | #MD,a1,a2,a3 ↵ | Contents of data area addresses a1 to a2 are moved to addresses a3 and after | VIII-43 |
| 9 | Data Set | #SP,a ↵ | Data from program area address "a" are written to memory | VIII-44 |
| | | #SD,a ↵ | Data from data area address "a" are written to memory | VIII-45 |
| 10 | Change CPU Internal Registers | #DR ↵ | Display evaluation board CPU internal registers | VIII-26 |
| | | #SR ↵ | Set evaluation board CPU internal registers | VIII-46 |
| | | #I ↵ | Reset evaluation board CPU | VIII-80 |
| | | #DXY ↵ | Display X, Y, MX and MY | VIII-35 |
| | | #SXY ↵ | Set data for X and Y display and MX, MY | VIII-47 |

*Table 2.1.4.1(b) Function-differentiated command list*

| Item number | Function | Command configuration | Description of operation | Reference page |
|---|---|---|---|---|
| 11 | History | #H,p1,p2 ↵ | Display history data for pointer 1 and pointer 2 | VIII-27 |
| | | #HB ↵ | Display upstream history data | VIII-30 |
| | | #HG ↵ | Display 21 line history data | VIII-30 |
| | | #HP ↵ | Display history pointer | VIII-33 |
| | | #HPS,a ↵ | Set history pointer | VIII-33 |
| | | #HC,S/C/E ↵ | Sets up the history information acquisition before (S), before/after (C) and after (E) | VIII-48 |
| | | #HA,a1,a2 ↵ | Sets up the history information acquisition from program area a1 to a2 | VIII-49 |
| | | #HAR,a1,a2 ↵ | Sets up the prohibition of the history information acquisition from program area a1 to a2 | VIII-49 |
| | | #HAD ↵ | Indicates history acquisition program area | VIII-49 |
| | | #HS,a ↵ | Retrieves and indicates the history information which executed a program address "a" | VIII-32 |
| | | #HSW,a ↵<br>#HSR,a ↵ | Retrieves and indicates the history information which wrote or read the data area address "a" | VIII-32 |
| 12 | File | #RF,file ↵ | Move program file to memory | VIII-70 |
| | | #RFD,file ↵ | Move data file to memory | VIII-70 |
| | | #VF,file ↵ | Compare program file and contents of memory | VIII-71 |
| | | #VFD,file ↵ | Compare data file and contents of memory | VIII-71 |
| | | #WF,file ↵ | Save contents of memory to program file | VIII-72 |
| | | #WFD,file ↵ | Save contents of memory to data file | VIII-72 |
| | | #CL,file ↵ | Load ICE set condition from file | VIII-73 |
| | | #CS,file ↵ | Save ICE set condition to file | VIII-73 |
| | | #OPTLD,n,file ↵ | Load HEXA data from file | VIII-74 |
| 13 | Coverage | #CVD ↵ | Indicates coverage information | VIII-36 |
| | | #CVR ↵ | Clears coverage information | VIII-36 |
| 14 | ROM Access | #RP ↵ | Move contents of ROM to program memory | VIII-76 |
| | | #VP ↵ | Compare contents of ROM with contents of program memory | VIII-77 |
| | | #ROM ↵ | Set ROM type | VIII-78 |
| 15 | Terminate ICE | #Q ↵ | Terminate ICE and return to operating system control | VIII-83 |
| 16 | Command Display | #HELP ↵ | Display ICE instruction | VIII-86 |
| 17 | Self Diagnosis | #CHK ↵ | Report results of ICE self diagnostic test | VIII-34 |

## *2.1.5 Alphabetical listing of commands*

Tables 2.1.5.1(a) and (b) show an alphabetical listing of ICE commands.

*Table 2.1.5.1(a) Alphabetical listing of commands*

| Item number | Command configuration | Description of operation | Reference page |
|---|---|---|---|
| 1 | #A,a ↵ | Assemble mnemonic instruction and store in address "a" | VIII-38 |
| 2 | #BA,a ↵ | Set break at program address "a" | VIII-52 |
| 3 | #BAR,a ↵ | Cancel breakpoint | VIII-52 |
| 4 | #BC ↵ | Display break condition | VIII-58 |
| 5 | #BD ↵ | Set break condition for RAM data | VIII-53 |
| 6 | #BDR ↵ | Cancels the data RAM break condition | VIII-53 |
| 7 | #BE ↵ | Break enable mode | VIII-66 |
| 8 | #BM ↵ | Assign multiple break condition for program address, RAM data and registers | VIII-56 |
| 9 | #BMR ↵ | Cancels the multiple break condition | VIII-56 |
| 10 | #BR ↵ | Break condition set for evaluation board CPU registers | VIII-54 |
| 11 | #BRR ↵ | Cancels the register break condition | VIII-54 |
| 12 | #BRES ↵ | All break conditions canceled | VIII-59 |
| 13 | #BRKSEL,REM ↵ | Sets BA clear/remain modes | VIII-68 |
| 14 | #BSYN ↵ | Break disable mode | VIII-66 |
| 15 | #BT ↵ | Sets break stop/trace mode | VIII-67 |
| 16 | #CHK ↵ | Reports results of ICE self diagnostic tests | VIII-34 |
| 17 | #CL,file ↵ | Loads ICE set condition from file | VIII-73 |
| 18 | #CS,file ↵ | Saves ICE set condition to file | VIII-73 |
| 19 | #CVD ↵ | Indicates coverage information | VIII-36 |
| 20 | #CVR ↵ | Clears coverage information | VIII-36 |
| 21 | #DD,a1,a2 ↵ | Displays contents of addresses a1 to a2 in the data area | VIII-24 |
| 22 | #DP,a1,a2 ↵ | Displays contents of addresses a1 to a2 in the program area | VIII-22 |
| 23 | #DR ↵ | Displays evaluation board CPU internal registers | VIII-26 |
| 24 | #DXY ↵ | Displays X, Y and MX, MY | VIII-35 |
| 25 | #FD,a1,a2,d ↵ | Sets d to addresses a1 to a2 in the data area | VIII-41 |
| 26 | #FP,a1,a2,d ↵ | Sets d to addresses a1 to a2 in the program area | VIII-40 |
| 27 | #G,a ↵ | Executes the program from the "a" address | VIII-60 |
| 28 | #H,p1,p2 ↵ | Displays history data for pointers 1 and 2 | VIII-27 |
| 29 | #HA,a1,a2 ↵ | Sets up the history information acquisition from program area a1 to a2 | VIII-49 |
| 30 | #HAD ↵ | Indicates the history acquisition program area | VIII-49 |
| 31 | #HAR,a1,a2 ↵ | Sets up the prohibition of the history information acquisition from program area a1 to a2 | VIII-49 |
| 32 | #HB ↵ | Displays upstream history data | VIII-30 |
| 33 | #HC,S/C/E ↵ | Sets up the history information acquisition before (S), before/after (C) and after (E) the break hit | VIII-48 |
| 34 | #HELP ↵ | Display ICE instructions | VIII-86 |
| 35 | #HG ↵ | Display history data in 21 lines | VIII-30 |

*Table 2.1.5.1(b) Alphabetical listing of commands*

| Item number | Command configuration | Description of operation | Reference page |
|---|---|---|---|
| 36 | #HP ↵ | Display history pointer | VIII-33 |
| 37 | #HPS,a ↵ | Set history pointer | VIII-33 |
| 38 | #HS,a ↵ | Retrieves and indicates the history information which executed the program address "a" | VIII-32 |
| 39 | #HSR,a ↵ | Retrieves and indicates the history information which read the data area address "a" | VIII-32 |
| 40 | #HSW,a ↵ | Retrieves and indicates the history information which wrote the data area address "a" | VIII-32 |
| 41 | #I ↵ | Reset evaluation board CPU | VIII-80 |
| 42 | #L,a1,a2 ↵ | Display disassembled contents of addresses a1 to a2 | VIII-20 |
| 43 | #MD,a1,a2,a3 ↵ | Move contents of data area addresses a1 to a2 to address a3 and after | VIII-43 |
| 44 | #MP,a1,a2,a3 ↵ | Move contents of program area addresses a1 to a2 to address a3 and after | VIII-42 |
| 45 | #OPTLD,n,file ↵ | Load HEXA data from file | VIII-74 |
| 46 | #OTF ↵ | Select on-the-fly display | VIII-82 |
| 47 | #Q ↵ | Terminate ICE and return to operating system control | VIII-83 |
| 48 | #RF,file ↵ | Move program file to memory | VIII-70 |
| 49 | #RFD,file ↵ | Move data file to memory | VIII-70 |
| 50 | #ROM ↵ | Select ROM type | VIII-78 |
| 51 | #RP ↵ | Move ROM contents to program memory | VIII-76 |
| 52 | #SD,a ↵ | Write data from address "a" of the data area | VIII-45 |
| 53 | #SP,a ↵ | Write data from address "a" of the program area | VIII-44 |
| 54 | #SR ↵ | Set evaluation board CPU internal registers | VIII-46 |
| 55 | #SXY ↵ | Display X, Y and set data to MX, MY | VIII-47 |
| 56 | #T,a,n ↵ | Execute while displaying n step instruction results from address "a" | VIII-63 |
| 57 | #TIM ↵ | Select execution time and step counter | VIII-81 |
| 58 | #U,a,n ↵ | Display only final step of #T,a,n | VIII-65 |
| 59 | #VF,file ↵ | Compare program file and memory contents | VIII-71 |
| 60 | #VFD,file ↵ | Compare data file and memory contents | VIII-71 |
| 61 | #VP ↵ | Compare contents of ROM and contents of program memory | VIII-77 |
| 62 | #WF,file ↵ | Save content of memory to the program file | VIII-72 |
| 63 | #WFD,file ↵ | Save content of memory to the data file | VIII-72 |

## 2.2 Connecting and Starting the System

The ICE connects to common personal computers and the S1C62 Family evaluation board for operation, as shown in Figure 2.2.1. The connection sequence described below should be followed.

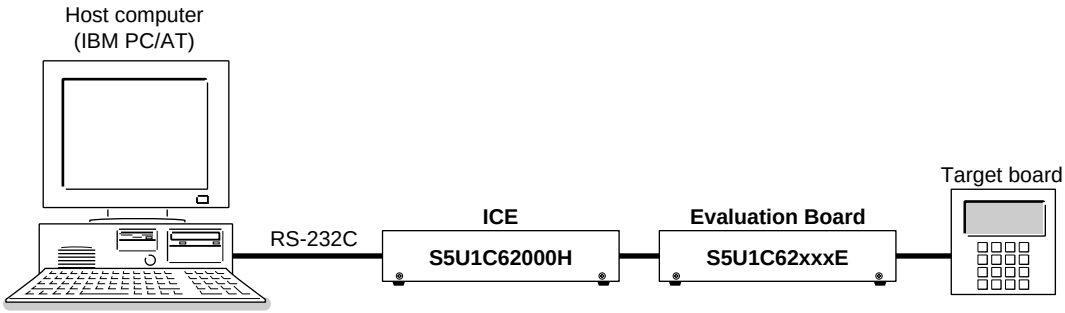



*Fig. 2.2.1 System connection diagram*

(1) Verify Power OFF Status

Make sure the power sources for the personal computer and ICE are switched OFF. (The S1C62 Family evaluation board is powered by the ICE power supply and thus has no power source.)

(2) Cable Connections

Connect cables in the manner prescribed in the "S5U1C62000H Manual".

(3) Power ON

Switch ON the power supplies for the personal computer and the ICE in any order.

### 2.2.1 *HOST settings*

The ICE is connected to a general purpose personal computer for operation.
The ICS62XX system program has an approximately 140KB capacity, and the personal computer must be set to proper operating parameters for the ICS62XX to operate. An example follows.

#### ■ Program Capacity

The ICS62XX system program requires a host system with a RAM capacity of about 140KB.

#### ■ RS232C Settings

ICE Operation Using a PC/XT, PC/AT System with PC-DOS v. 2.10
Execute MODE command soon after starting PC-DOS.

*Setting:*

```
A>MODE COM1:4800,n,8,1,P↵
COM1:4800,n,8,1,P          ... Settings can be confirmed.
A>
```

Set the ICE baud rate to 4800.

### *2.2.2 Starting the ICS62XX*

#### ■ Start the Operating System

First, call up the operating system (abbreviated OS below) for your general purpose personal computer. The ICS62XX can operate in the following OS environments.

*PC-DOS version 2.10 or higher*

Refer to your OS manual for procedures on loading the system. After loading the system, set the HOST setting as described in Section 2.2.1, "HOST settings".

#### ■ Starting the ICS62XX

(1) Insert the ICS62XX system software (supplied with CD-ROM) to the assigned drive in your personal computer.

(2) Input the following information through the keyboard.

```
B>ICS62XX↵
```
...The Epson logo is displayed for about one second...
```
* ICE POWER ON RESET *
* DIAGNOSTIC TEST OK *
# _
```
└ Cursor position

When the ICS62XX system program is loaded in the computer as described above, control of the computer is given to the ICS62XX system program. ICS62XX commands are awaited when the program is properly loaded and the # mark is displayed.

#### ■ Quitting ICS62XX Control

The ICS62XX program is terminated by entering the Q command; control is then returned to the computer's operating system.

```
#Q↵
B>
```

# 2.3 S5U1C62000H Operation and Functions

ICE operations, details on functions and emulation limitations are discussed in this section.

## 2.3.1 Operating features

Figure 2.3.1.1 shows a block diagram of ICE functions.
The ICE has a built-in control processor which processes ICE commands.

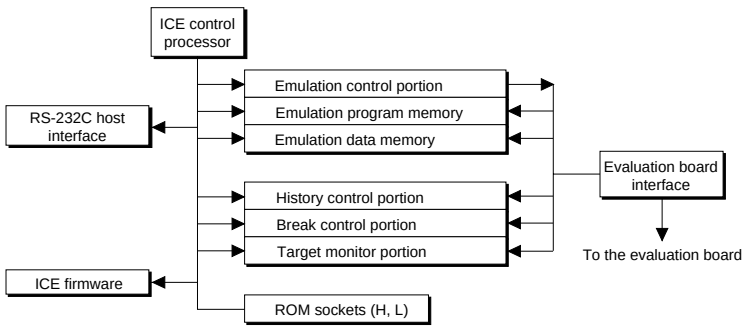



*Fig. 2.3.1.1 Block diagram of ICE functions*

Emulation consists of executing and terminating functions of the evaluation boardCPU and is controlled via the emulation control portion. The evaluation board CPU is halted unless the run (G command) or single step (T command) operations are invoked. In this condition the emulation lamp on the ICE display is OFF and the HALT lamp is ON to indicate the set-up mode. Thus, the A command, etc., are executed during the set-up mode.

The emulation program memory is set-up by instructions which activate the evaluation board CPU.
In the set-up mode, such operations as loading from the ROM sockets by the ICE control processor and program setting by the host processor are executed.
Similarly, the evaluation board CPU data RAM is allocated to the emulation data memory.
The history control portion records the execution bus cycles of the evaluation board CPU and consists of a 8192 word × 88 bit memory. The large memory capacity allows evaluation board CPU register values to be recorded in real time. The history is written in target run mode, and is analyzed by the ICE control processor in the set-up mode.

The break control portion has the functions which check the evaluation board CPU bus condition whether it is at a break point or not, and will stop the execution at the break point. Breaking at CPU register values is also possible in real time. The ICE control processor monitors the evaluation board CPU on the target monitor during target run mode. Results are displayed as on-the-fly information.

## 2.3.2 Break mode and break function

Breaks are supported in many modes.

(1) Break enable mode:
Makes the break function valid. Actions during break are decided according to the mode setting of break-trace / stop.

(2) Break disable mode:
Makes the break function invalid. ICE SYNC pin pulse output mode which does not terminate the G command when in break condition. This function can be used as an oscilloscope synchronous signal to measure the target circuit timing using the pulse as a reference.

(3) Break trace mode:
Temporarily stops the target run during break condition, and quickly restarts the program after displaying the CPU register and execution time. Effective for viewing the program operation timing, but not in true real time.

(4) Break stop mode:
A mode to break programs when they are consistent with break conditions.

Different types of breaks are described below.

(1) Reset switch:
Need not be in break mode to break. Used to reset the ICE; does not display the target register during break.

(2) Break switch:
Need not be in break mode to break. evaluation board CPU register is properly displayed during break.

(3) ESC key:
Break induced by ESC key input from the host. Need not be in break mode to break. Evaluation board CPU register is properly displayed during break.

(4) Break set command:
Break induced when CPU conditions and conditions set by BA, BD, BR or BM commands agree. Causes a break in break enable mode and break stop mode, but does not cause break in break disable mode. Cannot be set in break trace mode after completion of the instruction.

Table 2.3.2.1 shows the break modes and break types.

*Table 2.3.2.1 Break modes and break types*

| Item | Break mode | Break method | Description |
|---|---|---|---|
| 1 | Break enable<br>& break stop | * Reset switch<br>* Break switch<br>* ESC key<br>* Break instruction | Normal use mode.<br>Start up mode at power on.<br>Evaluation board CPU runs in real time by entering GO command after setting this mode. |
| 2 | Break enable<br>& break trace | * Reset switch<br>* Break switch<br>* ESC key | Activates the break trace function.<br>This mode is set by the BE command or BT command.<br>Register data is displayed when the evaluation board CPU agrees with the conditions set by the break set instruction.<br>Evaluation board CPU does not run in real time when GO command is entered after setting this mode. |
| 3 | Break disable<br>& break stop | * Reset switch<br>* Break switch<br>* ESC key | The SYNC output function is executed.<br>A pulse is output to the SYNC pin via the BSYN command when the CPU agrees with the condition set by the break set instruction.<br>Evaluation board CPU runs in real time by entering GO command after setting this mode. |
| 4 | Break disable<br>& break trace | ____ | Automatically sets to break disable and break trace.<br>Break enable mode is automatically set when break trace is set. |

### *2.3.3 SYNC pin and HALT pin output*

(1) SYNC Pin Output

When the instruction cycle conforms to a break condition, a low level pulse is output by the first half of the subsequent instruction fetch cycle.

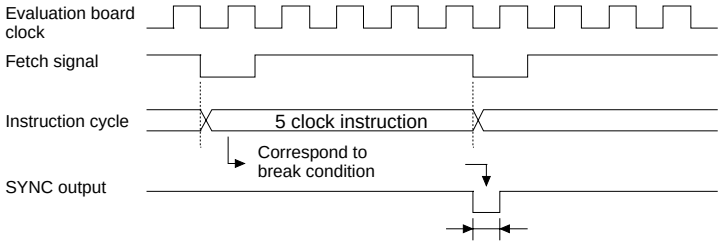



*Fig. 2.3.3.1 SYNC pin output*

(2) HALT Pin Output

A low level pulse is output when the evaluation board CPU is stopped (e.g., when the HALT or SLP instructions are executed).

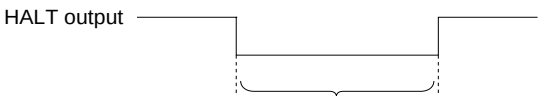



*Fig. 2.3.3.2 HALT pin output*

### *2.3.4 Display during run mode and during break*

During run mode, the ICE control processor monitors the state of the evaluation board CPU. Monitored data evaluation board CPU's executed program are displayed at intervals of about 500 msec when the on-the-fly display mode is set (by the OTF command).

```
#G↵
 *PC=0120    . . . Underlined portion is displayed in succession.
 *PC=HALT    . . . Enter HALT mode, line feed, and HALT is displayed.
 *PC=0200    . . . HALT is canceled, operation is restarted, and PC is redisplayed.
```

*Note HALT indicates execution of the HALT or SLP instruction.*
*When the printer is online and started, the PC values are printed in succession. PC is not displayed during on-the-fly inhibit mode.*
*During a break, the cause of the break, post break PC (the next executed program address), the contents of the CPU registers, and execution time are displayed.*

```
#G↵
 *PC=xxxx
 *EMULATION END STATUS=BREAK HIT              . . . (1)
 *PC=0201 A=0 B=0 X=070 Y=071 F=IDZC SP=10    . . . (2)
 *RUN TIME=425.097mS                          . . . (3)
```

(1) There are three statuses possible after completing the emulation: BREAK HIT, ESC KEY, OR BREAK SW. When a number of conditions prevail, only the highest priority position is displayed in the following priority ranking: BREAK SW > ESC KEY > BREAK HIT. A break may also be initiated by the reset switch; a reset switch break causes " ***ICE6200 RESET SW TARGET*** " to be displayed and instructions are awaited. The register display and execution time display are not active in this mode.

(2) The displayed PC shows the next executed value. Register values following "A" indicate the values during a break. In the above example, the values (indicated 2) results from completing to execute the instruction of address 0200.

(3) Execution time mode and step number mode can be set during run time (using the #TIM command). Millisecond is abbreviated to "mS". In step number mode, decimal values describe the run time, as in : " **`*RUN TIME=501 STEPS`** ".

When the execution time or step counters overflow, the message " **`*RUN TIME=TIMEOVER`** " is displayed. For more details, see Section 2.3.10, "Measurement during command execution".

### *2.3.5 Break assigning commands*

The ICE has a variety of break setting functions.

(1) Set break by PC:

Set by the BA command. The instruction is executed when the evaluation board CPU PC and the set values agree, thus inducing a break. When the PSET command is entered at the set address, the PSET and subsequent instruction are executed, then processing is halted. (When multiple PSET commands are specified, the instructions are executed until a command other than PSET is encountered.)
Breaks can be set for multiple PC's (to the maximum capacity of program memory).

(2) Set break by RAM data:

Set by the BD command. A break is induced by the RAM data address, data, or R/W AND condition. Also, masks can be set for address, data and R/W respectively.
When a break is induced by writing F data at address 10, the settings are: address=10, data=F, R/W=W. Any data can be used with the following settings: address=10, data=mask, R/W=W. A break will occur after execution of the memory access instruction which equals the set conditions. The break point can be set to one point through these settings.

(3) Set break by register value:

Set by BR command. When the register values of the evaluation board CPU coincide with the set break values, a break is initiated following execution of the instruction.
A break is induced by and AND condition set in the A, B, FI, FD, FZ, FC, X, or Y registers. Also, a mask can be set in any of the registers. When a break is induced with register A=5, X=70, and Y=0A, the other registers may be masked.

Example:

```
LD   A,5
LD   X,70
LD   Y,0A
```
. . . A break is induced when the above instruction is executed.

These settings will allow the operation to run in real time. The break point can be set at only one point.
Items (1), (2) and (3) above can be set independently.
When BA, BD and BR are set concurrently, a break will occur when any of the conditions coincide.

(4) Set compound break:

Set by BM command. A compound break occurs when breaks (1), (2) and (3) include AND statements. Breaks can have the following elements masked: (coincide with PC), (coincide with RAM data address, data, R/W), (register value). The break point can be set at only one point. At the current setting, setting (1) through (3) are automatically canceled. If settings (1) through (3) follow the current setting, the BM condition is canceled.

*Note* *Since the RAM data condition is a break element, the break will not be initiated without instructions which access the RAM data.*

### *2.3.6 Target interrupt and break*

When a target interrupt occurs the moment of a break it is given priority over the break. The break is then induced after the interrupt process is stacked. Next, the interrupt routine is executed from the top when the run mode commences.

The PC displayed during a break is the top interrupt address.

When a break is set by the BR command with FI=1, the break and interrupt are generated simultaneously, but due to the interrupt process, the register values after the break are:

```
*PC=0000  A=....  F=.DZC  X=000  Y=010
                     |
                  FI reset
```

so as to reset the FI flag status.

### *2.3.7 History function*

The evaluation board CPU information (PC, instruction code, RAM data address and data content, and CPU internal registers) while running an emulation are fetched to the history memory region with each CPU bus cycle. The history memory has a capacity of 8291 cycles, and can store 2730 (5 clock instructions only) to 1365 (12 clock instructions only) new instructions executed by the evaluation board.

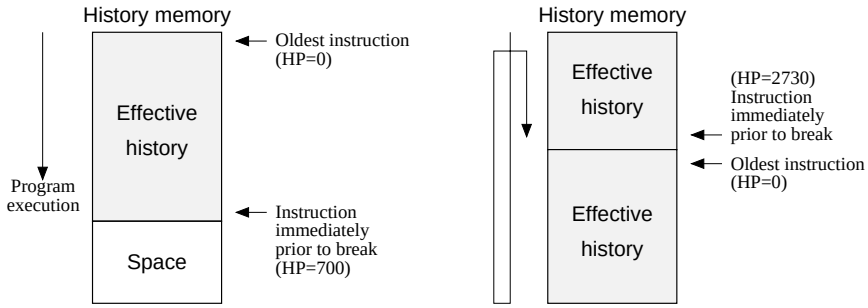



*Fig. 2.3.7.1 History function diagram*

Figure 2.3.7.1 shows a diagram of the history function. When the history memory is filled, old data is overwritten by new data.

The history pointer (HP) normally displays the oldest instruction at position 0, but during a break it displays the newest instruction. The maximum value of the HP is about 2730 when 5 clock instructions are executed.

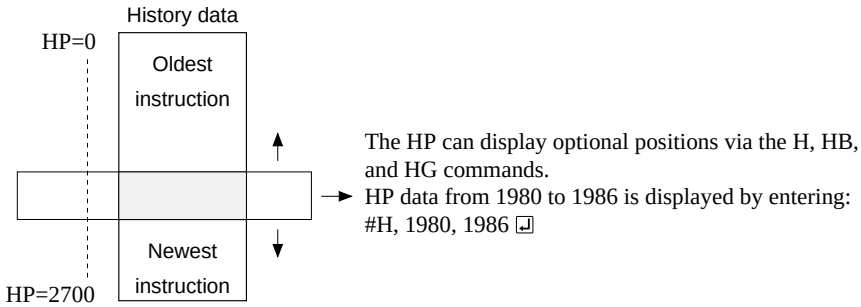



*Fig. 2.3.7.2 History data display*

```
  #H, 1980, 1986↵
  LOC   PC  IR  OP   OPR. A B  X   Y  IDZC MEMORY OPERATION     OTHER
  1980 0200 FC1 PUSH B    0 0 03F 03F 1111 W010=0
  1981 0201 423 CALL 23   0 0 03F 03F 1111 W00F=8 W00E=0 W00D=2    ...(1)
  1982 0223 FDF RET       0 0 03F 03F 1111 R00D=2 R00E=0 R00F=8
  1983 0202 FD1 PDP  B    0 0 03F 03F 1111 R010=0
* 1984                                     W010=8 W00F=0 W00E=2 INT1
  1985                                                          INT2
  1986 00FE FFF NOP7      0 0 0FF 0FF 0111
  └──┘ └──┘ └─┘ └──────┘ └──────────┘ └──┘ └──────────────────┘ └──┘
   (a)  (b)  (c)    (d)        (e)      (f)          (g)         (h)
```

(a) History pointer displayed

(b) Executed instruction address displayed

(c) Instruction code displayed

(d) Mnemonic instruction displayed

(e) Register value displayed when instruction completed

(f) When each flag is set, 1 is reset to 0 and displayed

(g) When a data memory R/W operation occurs during execution of an instruction, the data sequence write 8 to 0F address write 0 to 0E address write 2 to 0D address is sequentially displayed (1).

(h) During the interrupt process, INT1 (stack) and INT2 (vector) are displayed. The INT1 memory operation indicates the stack cycle.

*Note* ** During interrupt processing, two HP are renewed. Otherwise, HP is renewed by the instruction unit.*

### *2.3.8 Break delay function*

Users can refer to the programs until break by the history function mentioned in the previous section. In the ICE this function has been expanded so that the history information before hitting the break condition or before and after hitting break condition can be acquired and referred. To realize this function, this system is designed not to terminate the program right after the hit of break condition, but to terminate the program after acquiring specified history data. This specification is executed by the #HC command.

*Note* *When specifying the break delay by using the break enable & break stop mode (see Section 2.3.2, "Break mode and break function"), be sure that break is not made at the specified break condition.*

### *2.3.9 Coverage function*

ICE can acquire and indicate the address information of the program which was accessed during the execution of the program. One can confirm which parts have completed troubleshooting and debugging by referring to coverage information which is a result of executing programs for a long period of time. This coverage function is specified by #CVD, and #CVR commands.

### *2.3.10 Measurement during command execution*

The ICS62XX possesses a counting function which counts the time or the number of steps from starting the target program to the occurrence of a break.

The counting range is described below.

#### (1) Time counting mode

6.5 µsec to 6.5 × 65535 µsec (=425.977 msec)

Measurement error : ±6.5 µsec
(The display is in millisecond units: msec)

#### (2) Step counting mode

Step 1 to step 65535

Measurement error : 0 steps
(error of 1 step may be presumed during interrupt process)

When the measurement range is exceeded, the following message is displayed:

```
*RUN TIME=TIMEOVER.
```

### *2.3.11 Self-diagnostic function*

The ICE performs a self-check at power ON. When a check instruction (#CHK↵) is input from the host system, the self-test results are sent to the host.

```
#CHK↵
#          ...System awaits instruction unless an error occurs.
```

A check instruction is automatically input when the ICS62XX system program is loaded.

```
B>ICS62XX↵                    (Epson logo appears)
* ICE POWER ON RESET *
* DIAGNOSTIC TEST OK *        (Check instruction is automatically input; if no anomaly occurs, the
#                              following message appears)
```

When the above display appears, it indicates that the ICE and host are connected properly and the ICE is operating correctly.

If the ICE is power supply is OFF or the the cable to the host is not connected at the prompt, the following message appears:

```
B>ICS62XX↵
*COMMUNICATION ERROR OR ICE NOT READY*
```

Then, when the ICE power supply is switched ON, a self-test is automatically performed and the following message is displayed:

```
* ICE POWER ON RESET *
* DIAGNOSTIC TEST OK *
#
```

When an error message is displayed after entering the check instruction, it is likely to be due to hardware failure. Contact customer support.

### *2.3.12 Starting the printer*

The printer is controlled by the operating system. The printer can be started and stopped by entering "CTRL"+"P" key even while the ICS62XX system is running.

```
#BA,100↵
#"CTRL"+"P" T↵    . . . The monitor display following the "CTRL"+"P" key input is printed.
PC=300  IR=FFF    . . . SP=010
   ⋮
   ⋮
#"CTRL"+"P"       . . . Stops the printer
```

### *2.3.13 Limitations during emulation*

When running emulations with the ICE and evaluation board connected, the evaluation board CPU is normally stopped, as described in Section 2.3.1, "Operating features" (set up mode).

In the set up mode, the evaluation board CPU and peripherals are stopped, and inappropriate operations cannot be initiated. Until the set up mode is canceled and the target program is executed, the evaluation board CPU executes instructions provided by the command program of the ICE. The command program continues to operate when the emulation is completed and returns to the set up mode.

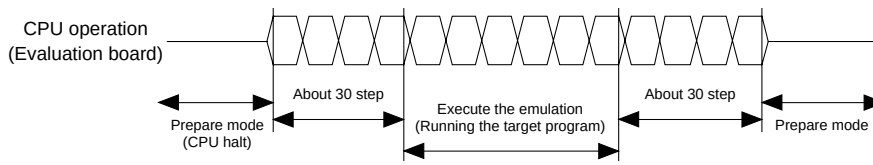



*Fig. 2.3.13.1 Evaluation board CPU operation*

You should be aware that when the command program takes over, the timers and counters are enabled and started from initial settings. Also, the watchdog timer is cleared immediately prior to the ICE switching to emulation mode while under command program control.
Accordingly, the following points should be noted when using the ICE.

(1) When execution of the trace instruction (T,U) is prolonged

Evaluation board timer values can be renewed while the command program is operative.

(2) When the run is halted and restarted

The watchdog timer is cleared by the ICE before and after the emulation, thus the watchdog timer is not continuous. The target program operates in real time when the run time is sufficiently long.

The command program runs approximately 30 steps before and after an emulation. When operating at 32 kHz clock speed, these steps require 6 msec + 6 msec = 12 msec. While at a clock speed of 455 kHz, the command program steps before and after emulation require 400 µsec + 400 µsec = 800 µsec.

When the dump data command (#DD) is invoked, the I/O area interrupt condition flag is read but not cleared.

# 3 COMMAND DETAILS

Detailed particulars on ICE commands and explanations of functions are described in this section. Commands are divided into six categories.

***DISPLAY:*** This command group displays the contents of program memory and data memory, and history information.

***SET:*** This group of commands modifies the contents of memory (program and data memories).

***BREAK and GO:*** Sets break conditions and starts emulations.

***FILE:*** Controls transfer of files from the host to the ICE.

***ROM:*** Controls the transfer of program memory and ROM (high and low) used by the evaluation board CPU.

***CONTROL:*** Sets the ICE operation mode (including initialization of the target system).

An S1C6S3N7/6S3B7/6S3L7 program is used in the examples, but output error messages may differ with the type of device used.

The methods for entering instructions described in Section 3.1 are as follows:

- A # mark is displayed when the program awaits instructions.
- Upper and lower case letters may be used to enter instructions.
- Individual instructions delineated by < > marks in the text should be separated by a comma when entering instructions.
- Interactive instructions imbeded in commands are displayed by key input. The interactive portions of instructions in the following examples are underlined in the text.
- The toggle instruction is set to reverse upon each command input.
- Notes indicates points for caution when using the described commands.

## 3.1 Display Command Group

# L *DISASSEMBLE LIST*

**Format**

**#L,** ***<address 1>*****,** ***<address 2>*****↵**

**#L,** ***<address 1>*****↵**

**#L↵**

**Function**

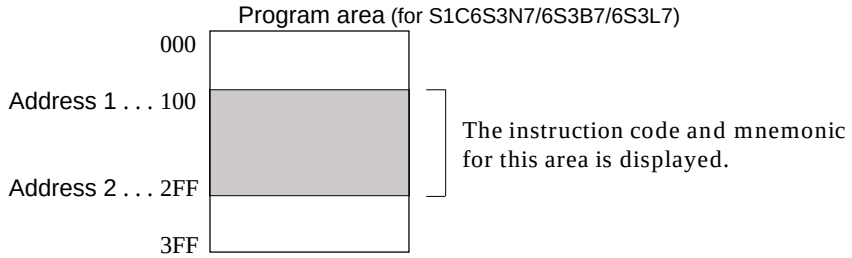
The program area (emulation program memory) is displayed disassembled from *<address 1>* to *<address 2>*.

(1) When *<address 2>* defaults, a single screen (22 lines) is displayed disassembled.

(2) When *<address 1>* and *<address 2>* default, a single screen is displayed disassembled from the previous address plus one (one more than the previous address).
With only L↵ input after power on, the data from address 0 onward is displayed.

(3) When more than a single screen is displayed disassembled, a single line space appears between each 22 lines with about a one second pause.

(4) The instruction can be interrupted by hitting the "ESC" key.



# *DISASSEMBLE LIST* L

**Format**

**#L,<*address 1*>,<*address 2*>↵**

**#L,<*address 1*>↵**

**#L↵**

**Examples**

```
#L,100,1FF↵
 0100 FDF RET
 0101 2FF JP C,FF
   :   :   :
 01FF FFF NOP7
```
... Contents of addresses 100 to 1FF of the program are displayed disassembled

```
#L,200↵
 0200 E00 LD A,0
 0201 E6F LDPX MX,F
   :   :   :
 0215 FFF NOP7
```
... Contents from address 200 onward (22 lines) are displayed

```
#L↵
 0216 FDF RET
 0217 E05 LD A,5
   :   :   :
 022B FFB NOP5
```
... One more than the previous address at which the program stopped are displayed

```
#L,100,FFF↵
 0100 FDF RET
   :   :   :
 0201 E6F LDPX MX,F
```
... Interrupt via "ESC" key input

```
#L,100,50↵
 * COMMAND ERROR *
```
... Address 1 > address 2 error

```
#L,100,100↵
 0100 FDF RET
```
... Contents of address 100 are disassembled, and executed normally

```
#L,3FC↵
 03FC E00 LD A,0
   :
 03FF 20F JP C,F
```
... Last program area (3FF address in the case of S1C6S3N7/6S3B7/6S3L7) is passed, and instruction terminates

```
#
```

# DP *DUMP PROGRAM*

**Format**

**#DP,** *<address 1>*, *<address 2>*↵

**#DP,** *<address 1>*↵

**#DP**↵

**Function**

The program area (emulation program memory) from *<address 1>* to *<address 2>* is displayed in hexadecimal format.

(1) When *<address 2>* defaults, the contents of *<address 1>* are displayed in a single screen (21 lines, 21×8=168 addresses).

(2) When *<address 1>* and *<address 2>* default, a single screen is displayed from the previous address plus one (one more than the previous address).
When DP↵ alone is entered after power on, the data from address 0 are displayed.

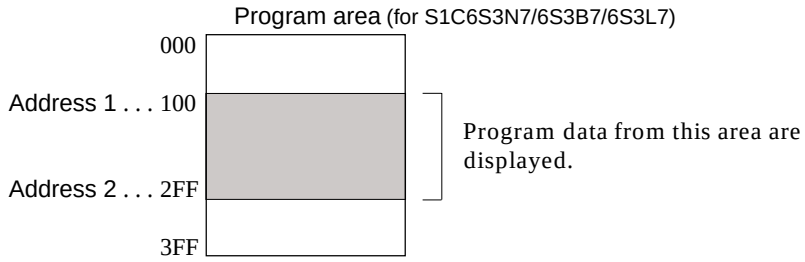
(3) When more than one screen of data is displayed, a one line space appears between every 21 lines with about a one second pause.

(4) Hexadecimal and ASCII codes can be displayed together, but the ASCII data operands are converted by the RETD and LBPX instructions before display.

Example: Data content 142 ... ASCII display B
(Instruction: RETD 42)

(5) When the last program area passes, the operation terminates.

(6) Commands can be interrupted by input from the "ESC" key.



# *DUMP PROGRAM* DP

**Format**

**#DP,**<*address 1*>**,**<*address 2*>↵

**#DP,**<*address 1*>↵

**#DP**↵

**Examples**

```
#DP,104,121↵          ...  Specified area is displayed
 ADDR   0    1    2    3    4    5    6    7   ASCII
 0100                      FFF  FFB  930  142      ..0B
 0108  FFF  FFF  FFF  FFF  FFB  931  142  944  .....1BD
   :    :    :    :    :    :    :    :    :
 0118  FFF  FFF  FFF  FFF  FFB  FFB  FFB  FFB  ........
 0120  131  145                                1E

#DP↵                    ...  21 lines are displayed
 ADDR   0    1    2    3    4    5    6    7   ASCII
 0120            131  132  145  FFF  FFB  FFB    12E...
   :    :    :    :    :    :    :    :    :
   :    :    :    :    :    :    :    :    :
                        21 line display

#DP,0,FFF↵
 ADDR   0    1    2    3    4    5    6    7   ASCII
 0000  FFF  FFF  FFF  FFF  FFF  FFF  FFF  FFF  .......
   :    :    :    :    :    :    :    :    :
   :    :    :    :    :    :    :    :    :
                       ...  Command interrupt via "ESC" key input

#DP,100,50↵           ...  Address 1 > address 2 error
 * COMMAND ERROR *

#DP,400,FFF↵          ...  Error due to exceeding maximum value of program
 * COMMAND ERROR *         area (3FF address in the case of S1C6S3N7/6S3B7/6S3L7)

#
```

# DD *DUMP DATA RAM*

**Format**

**#DD,<*address 1*>,<*address 2*>↵**

**#DD,<*address 1*>↵**

**#DD↵**

**Function**

Data in the RAM area from <*address 1*> to <*address 2*> are displayed in hexadecimal format.

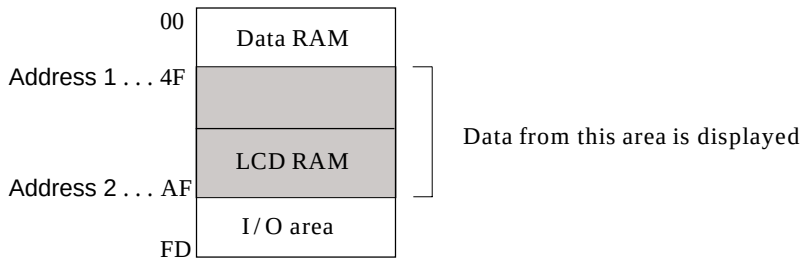
(1) When <*address 2*> defaults, the contents of <*address 1*> are displayed in a single screen (21 lines or the last RAM address).

(2) When <*address 1*> and <*address 2*> default, a single screen is displayed from the previous address plus one (one more than the previous address). When DD alone is entered after power on, the data from address 0 are displayed.

(3) The contents from the WRITE ONLY I/O area cannot be read.

(4) The I/O address with mixed R/W data is read and displayed with a ! mark.

(5) Commands can be interrupted by input from the "ESC" key.



(for S1C6S3N7/6S3B7/6S3L7)

**Examples**

```
#DD,80,BE↵
 ADDR 0 1 2 3 4 5 6 7 8 9 A B C D E F
 0080 5 2 3 4 A B B C D 0 F F F F F F
 0090 - - - - - - - - - - - - - - - -
 00A0 - - - - - - - - - - - - - - - -   ...  Write only area is displayed
 00B0 5 A 3 F 0 5 6 F 4 4 4 0 5 A A

#DD,100,FFF↵                  ...  Error results when RAM address exceeds 7E
 * COMMAND ERROR *                 (in the case of S1C6S3N7/6S3B7/6S3L7)

#DD,0↵
 ADDR 0 1 2 3 4 5 6 7 8 9 A B C D E F
 0000 F F F F F 0 0 0 0 0 0 1 1 1 2 3
   :                                 :
   :                                 :
 00AF 5 A 3 F 0 5 6 F 4 4 4 0 5 A A
                               ...  21 lines or last RAM address is displayed
```

# *DUMP DATA RAM* DD

**Format**

**#DD,**<***address 1***>**,**<***address 2***>↵

**#DD,**<***address 1***>↵

**#DD**↵

**Examples**

```
#DD↵                              ...  Display again from address 0 since last address
                                       exceeded (same as "#DD,0↵")

#DD,50,40↵
 * COMMAND ERROR *                ...  Address 1 > address 2 error

#DD,0,7E↵
 ADDR 0 1 2 3 4 5 6 7 8 9 A B C D E F
 0000 F F F F F 0 0 0 0 0 0 1 1 1 2 3
   :
                                  ...  Instruction terminated by "ESC" key input
#DD,E40,F1F↵
 ADDR 0 1 2 3 4 5 6 7 8 9 A B C D E F
 0E40 F 0 1 5 7 4 A 0 0 0 E F 3 2 0 1
                                                                  ...  When the unused area is one
 0E80 0 0 3 2 7 6 C 1 1 2 0 0 6 5 4 9                                  entire line, the display skips
 0E90 1 5 7 6 C F 3 2 0 1 0 1 E A C 0                                  that line (for S1C6S460)
 0EA0 0 0 0 1 4 0 5 0 0 0 3 0 0 1 5 2
 0EBC 4 3 2 7 6 B A 0 1 5 D 3 2 7 4 3
 0EC0 5 5 4 1 0 2 3 6 0 0 0 1 5 6 7 F

 0F00 ! ! ! ! ! / / / / / / / / / / ...  When addresses in the displayed
 0F10 F 0 1 0 F F / / / / / / / / /       lines are unused they are displayed
                                          as slashes (for S1C6S460)
#
```

**Note**

The read operation is invalid when the I/O address is set to write only.

# DR *DISPLAY CPU REGISTER*

**Format**

**#DR↵**

**Function**

Displays the value of the current register of the evaluation board CPU.

(1) PC: Displays the address which starts the next emulation.

(2) A, B, X, Y, F, SP: Displays the current value (break or after break value).

(3) IR, Mnemonic: Displays the mnemonic code for the PC program area command code.

**Example**

```
#DR↵
 * PC=0100 IR=FFF NOP7 A=0 B=0 X=06F Y=03A F=IDZC SP=10
#
```

Displays characters when F is set, or (.) mark when F is reset

# *HISTORY DATA DISPLAY* H

**Format**

***#H,<pointer 1>,<pointer 2>***↵

***#H,<pointer 1>***↵

**Function**

Displays history data.

(1) Displays history data from <*pointer 1*> to <*pointer 2*>.

(2) When <*pointer 2*> defaults, displays history data of <*pointer 1*> in 21 lines.

(3) Numerals displayed in <*pointer 1*> and <*pointer 2*> are decimal, from 0 to 9999.

(4) The following contents are displayed for each instruction:

| | | |
|---|---|---|
| LOC: | History pointer (decimal) | |
| PC: | Program counter (hexadecimal) | When a break, "PC" is displayed. |
| IR: | Command code (hexadecimal) | |
| OP: | Command mnemonic | |
| OPR: | Command operand | |
| A,B,X,Y: | Contents of A, B (Xp, Xh, Xl), (Yp, Yh, Yl) registers | |
| IDZC: | Binary display of flag bit (1 when set, 0 when clear) | |
| Other: | During execution of an instruction, the memory R/W cycle and data are displayed. Also, data interrupts INT1 (stack data) and INT2 are displayed | |

(5) History memory has a capacity of 8192 bus cycles. One the other hand, the S1C62 Family has 5, 7 and 12 clock instructions. The 5 clock instructions require three bus cycles, 7 clock instructions require four bus cycles, and 12 clock instructions require six bus cycles. Thus, the final value of the history pointer is changed according to the executed instruction. The maximum final value of the execution time for only a 5 clock instruction is approximately 2700, while the execution time for a 12 clock instruction is about 1300. When a break occurs before the history memory reaches the end, the last value of the history pointer is reduced.

(6) The history memory receives new data until a break occurs. Old data is erased when number of executed GO commands exceeds 2700.

(7) The top of the history pointer is 0. When the last value of <*pointer 2*> is set, the values are displayed to the last value.

(8) When there are no history data (Before GO command, after GO command execution, during T command execution, or during HAR command execution), the following message is displayed:

```
* NO HISTORY DATA *
```

(9) The HB command can be used to view history data immediately prior to a break.

# H *HISTORY DATA DISPLAY*

**Format**

**#H,** <***pointer 1***>**,** <***pointer 2***>↵

**#H,** <***pointer 1***>↵

**Examples**

```
#H,200,205↵                          ...   Set range displayed
  LOC    PC  IR OP   OPR.  A B   X   Y IDZC MEMORY OPERATION   OTHER
 0200  0128 FDO POP  A     F 0 020 021 0011 R01F=0
 0201  0129 F70 DEC  M0    0 0 020 021 0010 R000=1 W000=0
 0202  012A 722 JP   NZ,22 0 0 020 021 0010
 0203  012B F71 DEC  M1    0 0 020 021 0000 R001=2 W001=1
 0204  012C 721 JP   NZ,21 0 0 020 021 0000
 0205  0121 F80 LD   M0,A  0 0 020 021 0000 W000=0

#H,300↵                              ...   21 lines displayed
  LOC    PC  IR OP   OPR.  A B   X   Y IDZC MEMORY OPERATION   OTHER
 0300  000F C1F ADD  B,OF  F 4 02D 031 0001
 0301  0010 70E JP   NZ,OE F 3 02D 031 0001
 0302  000E EE8 LDPX MX,A  F 3 02D 031 0001 W02D=F
   :     :   :     :              :
 0319  0124 E10 LD   B,00  F 0 030 031 0001
 0320  0125 BD0 LD   X,D0  F 0 010 031 0001

#H,0,100↵
  LDC    PC  IR OP   OPR.  A B   X   Y IDZC MEMORY OPERATION   OTHER
 0000  0000 E1C LD   A,B   5 4 000 024 0000
 0001  0001 E16 LD   B,06  4 4 000 024 0000
 0002  0002 822 LD   Y,22  4 6 000 022 0000
 0003  0003 EF0 INC  Y     4 6 000 022 0000
 0004  0004 EF3 LDPY A,MY  4 6 000 023 0000 R023=0
 0005  0005 90A LBPX MX,0A 0 6 001 024 0000 W000=A W001=0
 0006  0006 C05 ADD  A,05  0 6 002 024 0000
 0007  0007 D52 SBC  B,02  5 6 002 024 0000
 0008* 0008 17F RETD 7F    5 4 003 024 0000 R01A=C R01B=9 R01C=1 W002=F W003=7
```

* Instruction terminates after exceeding last history memory

```
#H,310,3000↵
  LDC    PC  IR OP   OPR.  A B   X   Y IDZC MEMORY OPERATION   OTHER
 0310  0010 70E JP   NZ,0E F 0 020 021 0011
 0311  0011 8F1 LD   Y,21  F 0 020 021 0011
 0312  0012 E38 LD   MY,08 F 0 020 021 0011 W021=8
   :     :   :   :         : :  :   :    :
 2430  0172 E32 LD   MY,02 7 6 024 026 0000 W026=2
 2431  0173 F48 EI         7 6 024 026 0000
 2432  0174 FF8 HALT       7 6 024 026 1000
 2433                                       W01F=1 W01E=7 W01D=5 INT1
 2434                                                            INT2
 2435* 0108 0E6 JP   E6    7 6 024 026 0000
                                  ...   INT1 or INT2 displayed when interrupt only occurs
```

# *HISTORY DATA DISPLAY* H

**Format**

**#H,**<***pointer 1***>**,**<***pointer 2***>↵

**#H,**<***pointer 1***>↵

**Examples**

```
#H,0,500↵
  LOC    PC  IR OP   OPR.  A B   X   Y IDZC MEMORY OPERATION   OTHER
 0000  0010 70E JP   NZ,0E F B 015 021 0001
 0001  000E EE8 LDPX MX,A  F B 015 021 0001 W015=F
 0002  000F C1F ADD  B,0F  F B 016 021 0001
 0003  0010 70E JP   NZ,0E F A 016 021 0001
 0004  000E EE8 LDPX MX,A  F A 016 021 0001 W016=F
 0005  000F C1F ADD  B,0F  F A 017 021 0001
 0006  0010 70E JP   NZ,0E F 9 017 021 0001
 0007  000E EE8 LDPX MX,A  F 9 017 021 0001 W017=F
 0008  000F C1F ADD  B,0F  F 9 018 021 0001
 0009  0010 70E JP   NZ,0E F 8 018 021 0001
 0010  000E EE8 LDPX MX,A  F 8 018 021 0001 W018=F
                              ...   Instruction terminated by "ESC" key input
#
```

**Note**

The history data register value is changed by the line following the instruction execution (limited to "LD X,x" and "LD Y,y").

# HB, HG *HISTORY DATA DISPLAY BACKWARD/FORWARD*

**Format**

**#HB**↵

**#HG**↵

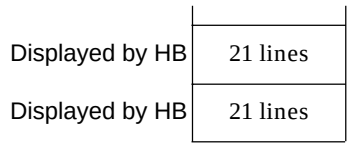
**Function**

Indicates the history information before and after the history pointer.

(1) HB: 21 instructions displayed from the current history pointer. The current pointer decrements 21 after display. (Validated in vicinity of last displayed history value.)

(2) HG: 21 instructions displayed from the current history pointer. The current pointer increments 21 after display. (Validated from old displayed history value by a screen.)

(3) The current history pointer indicates the last pointer after GO command completion.




← Current history pointer = last history pointer - 42 (Second HB execution)

← Current history pointer = last history pointer - 21 (First HB execution)

← Current history pointer = last history pointer (immediately after GO command)

**Examples**

```
#BA,108↵

#G,R↵
 *PC=
 *PC=HALT
 *EMULATION END STATUS = BREAK HIT
 *PC=01E6  A=7 B=6 X=024 Y=026 F=.... SP=4D
 *RUN TIME=TIMEOVER

#HB↵
  LOC    PC  IR OP   OPR.  A B   X   Y IDZC MEMORY OPERATION   OTHER
 2415  0423 83A LD   Y,3A  7 6 056 03A 0010
 2416  0424 CF1 OR   MY,01 7 6 056 03A 0000 R03A=0 W03A=1
 2417  0425 FDF RET        7 6 056 03A 0000 R01D=6 R01E=6 R01F=1
   :     :   :   :         : :  :   :    :
 2432  0174 FF8 HALT       7 6 024 026 1000
 2433                                       W01F=1 W01E=7 W01D=5 INT1
 2434                                                           INT2
 2435* 0108 0E6 JP   E6    7 6 024 026 0000
```

... When an HB command is executed after a break hit, 21 lines are displayed from the break address onward

## *HISTORY DATA DISPLAY BACKWARD/FORWARD* HB, HG

**Format**

**#HB↵**

**#HG↵**

**Examples**

```
#HPS,200↵

#HG↵                                ...   21 history pointer instructions displayed from 200
  LOC    PC  IR OP   OPR.  A B   X   Y IDZC MEMORY OPERATION   OTHER
 0200  0128 FD0 POP  A     F 0 020 021 0011 R01F=0
 0201  0129 F70 DEC  M0    0 0 020 021 0010 R000=1 W000=0
 0202  012A 722 JP   NZ,22 0 0 020 021 0010
 0203  012B F71 DEC  M1    0 0 020 021 0000 R001=2 W001=1
   :     :   :   :        : :  :   :    :
 0218  000F C1F ADD  B,0F  F E 013 011 0001
 0219  0010 70E JP   NZ,0E F D 013 011 0001
 0220  000E EE8 LDPX MX,A  F D 013 011 0001 W013=F

#HPS,200↵

#HB↵                                ...   21 history pointer instructions displayed from 200
  LDC    PC  IR OP   OPR.  A B   X   Y IDZC MEMORY OPERATION   OTHER
 0180  000F C1F ADD  B,0F  F 6 03B 021 0001
 0181  0010 70E JP   NZ,0E F 5 03B 021 0001
 0182  000E EE8 LDPX MX,A  F 5 03B 021 0001 W03B=F
 0183  000F C1F ADD  B,0F  F 5 03C 021 0001
   :     :   :   :        : :  :   :    :
 0198  0012 E38 LD   MY,08 F 0 020 021 0011 W021=8
 0199  0013 FDF RET        F 0 020 021 0011 R01C=8 R01D=2 R01E=1
 0200  0128 FDO POP  A     F 0 020 021 0011 R01F=0

#HG↵
  LDC    PC  IR OP   OPR.  A B   X   Y IDZC MEMORY OPERATION   OTHER
 2418  0166 B3A LD   Y,3A  7 6 03A 03A 0000
 2419  0167 CAE AND  MX,0E 7 6 03A 03A 0010 R03A=1 W03A=0
 2420  0168 BFE LD   X,2E  7 6 02E 03A 0010
 2421  0169 E20 LD   MX,00 7 6 02E 03A 0010 W02E=0
 2422  016A BF0 LD   X,20  7 6 020 03A 0010
 2423  016B 980 LBPX MX,B0 7 6 021 03A 0010 W020=0 W021=8
 2424  016C 9C1 LBPX MX,C1 7 6 023 03A 0010 W022=1 W023=C
                                   ...   Instruction terminated by "ESC" key input
#
```

# HS, HSR, HSW *HISTORY SEARCH PC/MEMORY READ/MEMORY WRITE*

**Format**

**#HS,** <*address*>↵

**#HSR,** <*address*>↵

**#HSW,** <*address*>↵

**Function**

Retrieves and indicates history information under the following conditions.

(1) HS: Indicates the history information of the PC address specified by <*address*>.

(2) HSR: Indicates the history information which read the memory specified by <*address*>.

(3) HSW: Indicates the history information which wrote the memory specified by <*address*>.

**Examples**

```
#HS,0700↵          ...   Retrieves and indicates the history information of PC = 700
  LOC    PC  IR OP   OPR.  A B   X   Y IDZC MEMORY OPERATION   OTHER
 1980  0700 FC1 PUSH B     0 0 0FE 0FF 1111 W0F0=0
 2038  0700 FC1 PUSH B     5 1 0FE 0F0 1001 W0FE=1
   :
   :

#HSR,30↵           ...   Retrieves and indicates the history information which read address 30
  LOC    PC  IR OP   OPR.  A B   X   Y IDZC MEMORY OPERATION   OTHER
 0820  0640 EC2 LD   A,MX  0 0 030 0FF 1111 R030=0
 0950  084F EC6 LD   B,MY  0 F 030 0FF 1111 R030=F
   :
   :

#HSW,30↵           ...   Retrieves and indicates the history information which wrote address 30
  LOC    PC  IR OP   OPR.  A B   X   Y IDZC MEMORY OPERATION   OTHER
 0838  0650 E60 LDPX MX,0  0 0 030 0FF 1111 W030=0
 0950  084F E71 LDPY MY,1  0 0 0FF 030 1111 W030=1
   :
   :

#
```

## *HISTORY POINTER DISPLAY/SET* HP, HPS

**Format**

**#HP**↵

**#HPS,** <***history pointer***>↵

**Function**

(1) HP: Displays current history pointer value.

(2) HPS: Sets the displayed history pointer value in the current history pointer. When a value is input which exceeds the last history pointer, the last pointer value is set to the current history pointer.

(3) The history pointer is displayed in four lines of decimal code, and set.

**Examples**

```
#HP↵
 * LOC=2058          ...  Pointer (last value) displayed at break

#HPS,1000↵          ...  Pointer set to 1000

#HP↵
 * LOC=1000          ...  Pointer value = 1000

#HPS,9999↵
 * LOC=2058          ...  Return to last pointer value
                          Last pointer value is validated when last value is exceeded
#HP↵
 * LOC=2058

#
```

# CHK *CHECK ICE HARDWARE*

**Format**

**#CHK↵**

**Function**

Displays the results of the ICE initial test. (ICE executes the initial test at power on.)

The test consists of the following:

(1) Sum check test of ICE firmware

(2) ICE RAM R/W test

**Examples**

```
#CHK↵
 * ROM CHECK ERROR 5F=>FF *
 * RAM CHECK ERROR 001111 55=>FF *
```

Message is displayed when an error is detected

```
#CHK↵

#                          ...
```

A waits command under normal conditions

**Note**

When an error message is displayed, avoid further use of the device since it is likely due to hardware failure.

## *DISPLAY X, Y REGISTER & MX, MY CONTENT* DXY

**Format**

**#DXY↵**

**Function**

Displays current X register (Xp, Xh, Xl) and Y register (Yp, Yh, Yl), as well as MX and MY (contents of memory specified by codes X and Y).

**Examples**

```
#DXY↵
 X=070  MX=  5
 Y=07C  MY=  F

#DXY↵
 X=200  MX=-:OV     ...  Indicates the RAM area has been exceeded;
 Y=050  MY=-             read operation not viable
           :.......  Indicates write only area; read operation not viable

#DXY↵
 X=E73  MX=  /      ...  Shows that E73 is unused area
 Y=252  MY=  F      ...  Read operation not viable

#
```

# CVD, CVR *DISPLAY/RESET COVERAGE*

**Format**

**#CVD,** *<address 1>*, *<address 2>*↵

**#CVD**↵

**#CVR**↵

**Function**

Indicates and clears coverage information.

(1) CVD: Indicates the coverage information ranging from *<address 1>* to *<address 2>*. Indicates all coverage information when address are omitted.

(2) CVR: Clears coverage information.

**Examples**

```
#CVD,100,110↵          ...  Indicates the coverage information ranging
 *CV 0100                   from address 100 to 110
 *CV 0109..0110
#

#CVD↵                  ...  Indicates the whole coverage information
 *CV 0100
 *CV 0109..02FF
 *CV 0400..04FF
#

#CVR↵                  ...  Clear coverage information
#
```

## 3.2 Set Command Group

# A *ASSEMBLE PROGRAM*

**Format**

**#A,<*address*>↵** **(With guidance)**

**Function**

The mnemonic command is assembled and stored at the address indicated by <*address*>.

(1) Supports the mnemonics and operands in the instruction list used in the S1C62 Family.

(2) Operand expressions follow the configurations below:

| | |
|---|---|
| p: | 00 to 03 values |
| s: | 00 to FF values |
| l: | 00 to FF values |
| i: | 00 to 0F values |
| r,q: | A, B, MX or MY |

In general, hexadecimal expressions do not have "H" appended at the end.

Three digit data can be input starting from the 0 column.

| | |
|---|---|
| 0FF input: | Validates FF |
| 00FF input: | Causes an error |

An error is generated by invalidated values entered for p, s, l or i.

Only binary expressions (xxxxB) are allowed in the input area. The x in this case has a fixed length of from one to four digits comprised either of 0 or 1, with "B" input last.

When less than three digits are input, the expression is handled as a binary expression or an error.

(3) Either upper or lower case letters may be used for input.

(4) Mnemonic and operand codes should be separated by one or more character spaces or by a tab code.

(5) An error is generated when an unsupported instruction is entered.

(6) A or B input gains register priority. Input 0A or 0B when entering immediate value settings.

```
LD   A,B      Contents of B register are input to A register.
LD   B,0A     Immediate value A is loaded to B register.
```

# *ASSEMBLE PROGRAM* A

**Format**

**#A,**<***address***>↵ **(With guidance)**

**Examples**

```
#A,100↵
 0100 LD A,0F↵        ...  Instruction entered by key input
                           Address displayed; mnemonic input awaited (mnemonic
                           instruction, operand input)
 0101 /↵              ...  /↵ input cancels instruction

#A,200↵
 0200 PUSH XP↵        ...  Error generated by unapproved mnemonic input
     * ERROR *             (for S1C62XXX); same address is redisplayed
                           with mnemonic request
 0200 NOP5↵
 0201 JJJ 0FF↵
     * ERROR *
 0201 LD A,FF↵        ...  Error generated when valid operand range is exceeded
     * ERROR *
 0201 LD A,0F↵
 0202 /↵

#A,202↵
 0202 ^↵              ...  Return to previous address (current address less one) via
 0201 /↵                   ^ key input

#
```

**Note**

"ESC" key nonfunctional; cancel operation by entering /↵.

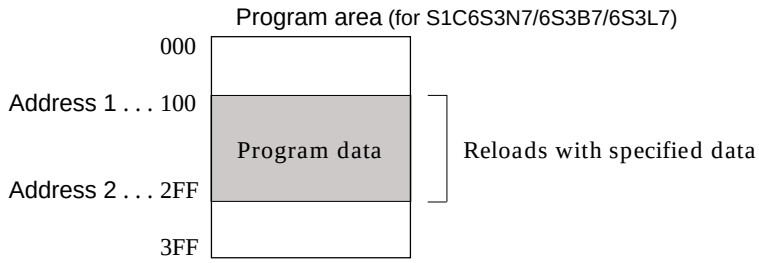
# FP *FILL PROGRAM*

**Format**

**#FP,** ***<address 1>*****,** ***<address 2>*****,** ***<program data>*** ↵

**Function**

Data *<program data>* is stacked in the program area (ICE emulation memory) at *<address 1>* to *<address 2>*.




**Examples**

```
#FP,0,3FF,FFB↵                  ...  Data from addresses 000 to 3FF of the program area
                                     are stacked to the FFB (NOP5 code)

#FP,100,200,FF9↵                ...  When undefined code is detected, an error message is
 * COMMAND ERROR *                   displayed and the instruction will not execute

#FP,200,100,FFF↵
 * COMMAND ERROR *               ...  Address 1 > address 2 error

#FP,200,200,FFF↵                ...  Address 200 is modified to instruction code FFF (NOP7);
                                     instruction completes normally
#
```

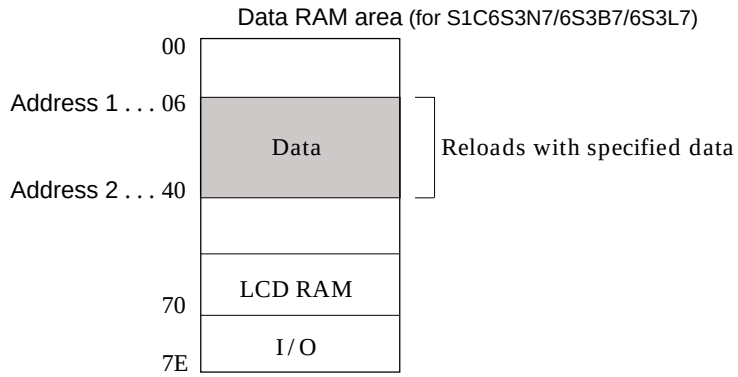
# *FILL DATA RAM* FD

**Format**

**#FD,<*address 1*>,<*address 2*>,<*data*>↵**

**Function**

<*data*> is stacked in the data RAM area at <*address 1*> to <*address 2*> in hexadecimal or binary code.




**Examples**

```
#FD,60,7E,A↵          ...  Reloads the contents of the data RAM addresses 60 to 7E to A

#FD,10,2F,0101B↵      ...  Reloads address 10 to 2F with data 0101 (binary) = 5 (hexadecimal)

#FD,50,1FF,0↵         ...  Error is generated because settings exceed the RAM area
 * COMMAND ERROR *         (address 7E for S1CS1C6S3N7/6S3B7/6S3L7) and the
                           instruction will not execute

#FD,70,60,0↵
 * COMMAND ERROR * ...  Address 1 > address 2 error

#FD,0,7E,B↵           ...  Reloads the entire RAM area (for S1C6S3N7/6S3B7/6S3L7)
                           with data B (hexadecimal)

#FD,40,40,0↵          ...  0 written to 40 address

#
```

**Notes**

(1) For binary expressions, four digit 0 (or 1) and B input (total of five characters) only are accepted.

(2) Write operation is not performed to the read only address of the I/O area.

(3) When there is an unused area in the specified address, the data is rewritten except for the unused area.

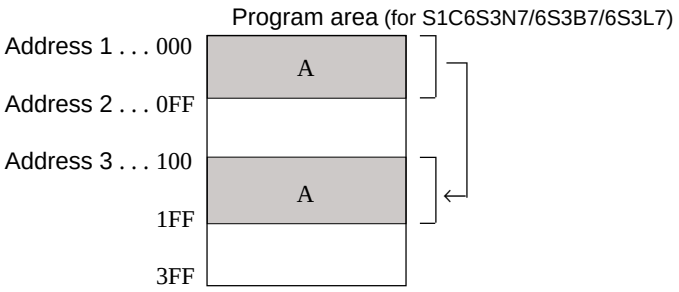
# MP *MOVE PROGRAM*

**Format**

**#MP,<*address 1*>,<*address 2*>,<*address 3*>↵**

**Function**

Contents of program area <*address 1*> to <*address 2*> are transferred to <*address 3*> and above.




**Examples**

```
#MP,0,FF,100↵                ...  Contents of program area addresses 000 to 0FF are
                                  transferred to addresses 100 to 1FF
#MP,100,2FF,300↵             ...  When the transfer area surpasses address 3FF, an error
 * COMMAND ERROR *                message is displayed and the instruction will not execute

#MP,200,100,300↵
 * COMMAND ERROR *           ...  Address 1 > address 2 error

#MP,200,200,300↵             ...  Contents of address 200 are copied to address 300, then
                                  the instruction is executed normally
#
```

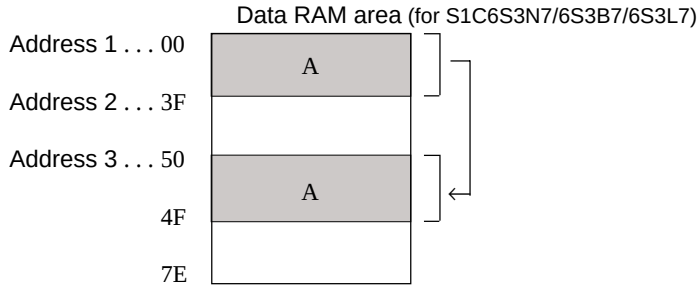
# *MOVE DATA RAM* MD

**Format**

***#MD,<address 1>,<address 2>,<address 3>***↵

**Function**

Contents of *<address 1>* to *<address 2>* in the data RAM area are transferred to *<address 3>* and above.




**Examples**

```
#MD,10,1F,30↵
#MD,00,3F,70↵
 * COMMAND ERROR *
#MD,30,20,50↵
 * COMMAND ERROR *
#MD,30,30,50↵
#MD,E00,E1F,E60↵
 * UNUSED AREA *
#
```

. . . Contents of data RAM addresses 10 to 1F are moved to addresses 30 to 3F

. . . When the transfer area exceeds the RAM area (7E for S1C6S3N7/6S3B7/6S3L7), an error is indicated and commands are not executed

. . . Address 1 > address 2 error

. . . Contents of address 30 are copied to address 50, then instruction is executed normally

. . . When there is an unused area in the transfer area (either sending or receiving side), an unused area error message is displayed (for S1C6S460)

**Notes**

(1) A write operation cannot execute when the top transferred address coincides with the I/O area read only region.

(2) A read operation cannot execute when the bottom transferred address coincides with the I/O area write only region. In this case a 0 is written to the top address.

(3) When the transfer address coincides with an I/O address of mixed readable bits and write only bits, either read or write operations can execute.

# SP *SET PROGRAM*

**Format**

**#SP,** <*address*>↵ **(With guidance)**

**Function**

Contents of the specified program area <*address*> are displayed or modified.

**Examples**

```
#SP,100↵
 0100 FFF:↵                 ...  Contents of address 100 are read, and cannot be modified
                                 by a ↵ alone
 0101 FFF:FFB↵              ...  New data is written
 0102 FFF:FF9↵
 * CODE ERROR *            ...  Error message is displayed when undefined code is
                                 detected; contents are written unchanged to the same
                                 address
 0102 FFF:F05↵
 0103 FFF:A6B↵
 0104 FFF:^↵                ...  Operation returns to previous address (one less than
 0103 A6B:^↵                     current address) via input by entering ^↵
 0102 F05:F06↵
 0103 A6B:↵
 0104 FFF:ABx↵
 * COMMAND ERROR *          ...  Error is generated by data setting error; message displayed
 0104 FFF:ABC↵
 0105 FFF:/↵                ...  /↵ input terminates instruction

#SP,400↵
 * COMMAND ERROR *          ...  Since it exceeds the program area (3FF for S1C6S3N7/
                                 6S3B7/6S3L7), an error is indicated
#SP,3FE↵
 3FE FFF:011↵
 3FF FFF:FFB↵               ...  Instruction is completed after last address in input

#
```

# *SET DATA RAM* SD

**Format**

**#SD,<*address*>↵** **(With guidance)**

**Function**

Contents of the data RAM area <*address*> are displayed or modified.

(1) Data cannot be written to the read only area.

(2) Data in the write only area cannot be read.

**Examples**

```
#SD,20↵
 20 5:A↵                    ...  Contents of address 20 are modified and stored to A
 21 5:^↵                    ...  Return to previous address (one less than the current
 20 A:B↵                         address) by entering ^↵
 21 5:F↵
 22 5:7↵                    ...  Instruction terminated by /↵

#SD,FFF↵
 * COMMAND ERROR *          ...  When specification exceeds the maximum value of the
                                  RAM area (7F for S1C6S3N7/66S3B7/6S3L7), an
                                  error is indicated

#SD,70↵
 70 4:-↵
 71 F:-↵                    ...  Hyphen only displayed due to read only address;
 72 5:-↵                         data input not accepted
 73 6:-↵
 74 6:5↵
 75 8:4↵
 76 5:A↵
 77 8:9↵
 78 8:5↵
 79 A:-↵
 7A B:-↵
 :  :  :
 7E F:-↵                    ...  Command terminates after last address entered

#SD,E50↵
 * UNUSED AREA *            ...  When an unused area has been specified, "UNUSED
                                  AREA" is displayed (for S1C6S460)

#SD,ECE↵
 ECE 0:F↵
 ECF 4:F↵
 * UNUSED AREA *            ...  When an unused area is entered into during data setting,
                                  "UNUSED AREA" is displayed (for S1C6S460)
```

# SR *SET REGISTER*

**Format**

**#SR↵** **(With guidance)**

**#SR,<*register name*>,<*data*>↵**

**Function**

#
Evaluation board CPU registers are displayed and modified.

(1) <*data*> is set in specified registers.

**Examples**

(2) <*register name*> can be specified as: PC, A, B, X, Y, FI, FD, FZ, FC, and SP.

```
#SR↵
 PC=0100:0105↵          ...  Input data and ↵ to registers you wish to modify enter
  A=   5:↵                    ↵ only to skip to the next register
  B=   A:5↵
  X= 02F:20↵
  Y= 010:1A↵
 FI=   0:1↵
 FD=   1:↵
 FZ=   0:↵
 FC=   1:0↵
 SP=  4F:^↵             ...  Entering the ^↵ returns operation to previous register
 FC=   0:1↵                  (one less than the current register)
 SP=  4F:↵

#SR,X,AA↵               ...  X register only is changed to AA

#SR↵
 PC= 105:↵              ...  Current value is saved with ↵ key input
  A=   5:↵
  B=   5:↵
  X=  2A:↵
  Y=  2A:↵
     :
 SP=  4F:↵
```

**Note**

#

# *SET MX, MY DATA* SXY

**Format**

**#SXY↵** **(With guidance)**

**Function**

Instruction will not complete with /↵ input; use ↵ up to the last register.
Current contents of the X register (Xp, Xh, Xl), Y register (Yp, Yh, Yl), and MX and MY

**Examples**

(contents specify memory X, Y) are displayed. Contents of MX and MY can also be modified.

```
#SXY↵                                  ...  Display only; ↵ alone continues operation
 X=040 MX=5:↵
 Y=030 MY=A:↵

#SXY↵
 X=040 MX=5:0↵                         ...  Sets new data to MX, MY
 Y=030 MY=A:F↵

#SXY↵
 X=070 MX=3:-                          ...  Data to read only area not accepted
 Y=FFF MY=-:OV                         ...  Input not accepted if RAM area is exceeded

#SXY↵
 X=E52 MX * UNUSED AREA *              ...  An unused area error message is displayed
 Y=1A7 MY=1:3↵                              for E52 (for S1C6S460)
```

# HC *SET HISTORY CONDITION*

**Format**

**#HC,S/C/E↵**

**Function**

#
Sets up the area for history extraction by means of the break point.

**Examples**

"[ ]" is added to the break point.

| | | |
|---|---|---|
| #HC,S↵ | . . . | Extracts the history from the break point |
| #HC,C↵ | . . . | Extracts the history before and after the break point |
| #HC,E↵ | . . . | Extracts the history up to the break point (default value) |

## *SET/DISPLAY/RESET HISTOY RANGE* HA, HAD, HAR

**Format**

**#HA,** *<address 1>*,*<address 2>*/**ALL**↵

**#HAD**↵

**#HAR,** *<address 1>*,*<address 2>*/**ALL**↵

**Function**

#
Sets up, indicates and clears PC address within the history extraction area.

(1) HA: Extract the range specified by *<address 1>* and *<address 2>*.
When specifying ALL, all addresses will be specified.

(2) HAD: Indicates the address of history extraction area.

(3) HAR: Do not extract the range specified by *<address 1>* and *<address 2>*.

**Examples**

When specifying ALL, history isn't extracted.

```
#HAR,ALL↵                    ...  Clears the entire history extraction area

#HA,300,400↵                 ...  Specifies history extraction area

#HA,100,200↵

#HA,500,500↵

#HAD↵                        ...  Indicates history extraction area
 *HA 0100..0200
 *HA 0300..0400
 *HA 0500

#
```

## 3.3 Break and Go Command Group

# BA, BAR *SET/RESET BREAK ADDRESS CONDITION*

**Format**

**#BA,** *<address 1>*, *<address 2>*, *<address 3>*, *<address 4>*↵

**#BAR,** *<address 1>*, *<address 2>*, *<address 3>*, *<address 4>*↵

**Function**

Sets break condition for the PC.

(1) BA: The value indicated at the specified *<address>* is set to the break condition. Multiple addresses are set by using commas to divide them. Consecutive addresses are set by separating entries with two period marks (.). Entering *<address 3>..<address 4>* sets a break condition such that *<address 3>* ≤ PC ≤ *<address 4>*.

(2) BAR: Can be cleared separately from break condition set by BA.

(3) Addresses which can be entered by a single BA or BAR instruction can be set multiple times in a single line (80 columns).

(4) When the BA command is executed several times, previous settings are valid.

(5) When the BM command is executed, all BA conditions are canceled.

(6) When entering the GO command at a break, the BA condition may enter the clear mode or a condition retaining mode. (Refer to the BRKSEL command.)

**Examples**

```
#BA,100,200,101,1FF↵      ...  Break condition set at addresses 100, 200, 101 and 1FF

#BA,300..3FF↵             ...  Break conditions set at addresses 300 to 3FF

#BAR,100,200..3FF↵        ...  Break conditions canceled at address 100 and addresses
                               200 to 3FF (although break conditions were not set at
                               addresses 201 to 2FF, no error occurs even with BAR
                               setting)

#BC↵
 BA 0201                  ...  BA condition is displayed by BC command
 BA 02FF
 BD NONE
 BR NONE
  :
#
```

# *SET/RESET BREAK DATA CONDITION* BD, BDR

**Format**

**#BD↵** **(With guidance)**

**#BDR↵**

**Function**

Break condition set for data RAM read / write area.

(1) BD: Break condition set for RAM data address, data, and R / W. Address can be set at one point, data set from addresses 0 to F or masked, and the R / W area set to read, write, or masked. A break is generated when the three conditions specified by address, data, and R / W coincide.

(2) BDR: Cancels the condition set by BD command.

(3) A break condition set by the BD command is functional at one point only, but can be mixed with BA and BR commands.

(4) A BD condition can be canceled by executing the BM command.

**Examples**

```
#BD↵
 ADDR ---:074↵          ...  A hyphen (-) is displayed when the BD condition is absent
 DATA   -:5↵                 At address 74, the number 5 is entered as data and the R/W
 R/W    -:*↵                 is masked (*)
```

In the above example, a break is set for when the number 5 is written to or read from the data RAM address 074.

```
#BD↵
 ADDR 074:↵             ...  When no setting modification is made, hitting the ↵ key
                             continues the operation to the next setting
 DATA  5 :1*1*B↵        ...  Data is masked
 R/W   * :W↵            ...  Sets the R/W function to write
```

At the current settings, a break is generated when 1 is written to $2^3$ bit and $2^1$ bit at data RAM address 74.

```
#BDR↵                   ...  All BD conditions are cleared

#BD↵
 ADDR ---:↵             ...  Entering ↵ after canceling BD setting confirms cancellation

#
```

# BR, BRR *SET/RESET BREAK REGISTER CONDITION*

**Format**

**#BR↵** **(With guidance)**

**#BRR↵**

**Function**

A break condition is set in the evaluation board CPU registers A, B, FLAG, X (Xp, Xh, Xl,) or Y (Yp, Yh, Yl).

(1) BR: A break condition is set in the target registers A, B, FLAG, X (Xp, Xh, Xl,) or Y (Yp, Yh, Yl). The break condition in each register can be masked (a masked register can generate a break in another register, whatever the specified value). Break is induced when the values of each register correspond to the set values in the internal CPU registers.

(2) BRR: Cancels a break condition set by BR command.

(3) A break set by the BR command is operative at one point. BA and BD settings can be mixed.

(4) A BR condition can be canceled by executing the BM command.

**Examples**

```
#BR↵
 A       -:C↵
 B       -:*↵
 FI      -:1↵
 FD      -:*↵
 FZ      -:0↵
 FC      -:*↵
 X     ---:040↵
 Y     ---:^↵
 X     ---:041↵
 Y     ---:030↵
```

... A hyphen (-) is displayed when a BR condition is not set
Break condition is sequentially set

... Enter an asterisk (*) mark to indicate masking
This induces a break unrelated to the FD value

... If a parameter is mis-set, entering the ^ key will return the operation to the previous setting (one less than the current setting)

A break condition set as described above, where A=C, FI=1, FZ=0, X=41, and Y=30.

```
#BR↵
 A       C:↵
 B       *:↵
 FI      1:*↵
 FD      *:↵
 FZ      0:*↵
 FC      *:↵
 X     041:042↵
 Y     030:*↵
```

... Reads a previously set break condition
When no setting modification is made, hitting the ↵ key continues the operation to the next setting

Two break conditions where A=C and X=42 are described above.

# *SET/RESET BREAK REGISTER CONDITION* BR, BRR

**Format**

**#BR**↲ **(With guidance)**

**#BRR**↲

**Examples**

```
#BRR↲                          ...  A BR condition is cleared by the BRR command

#BR↲
 A        -:↲                  ...  Entering ↲ after canceling BR setting confirms cancellation

#BR↲
 A        -:0↲
 B        -:0↲
 FI       -:*↲
 FD       -:*↲
 FZ       -:*↲
 FC       -:*↲
 X      ---:40↲
 Y      ---:30↲
```

A break condition is set wherein A=0, B=0, X=40, and Y=30.

```
#BR↲
 A        0:↲
 B        0:5↲
 FI       *:7↲                 ...  Entering / when no further setting changes are desired
                                    completes the instruction
```

A break condition is set where A=0, B=5, X=40, and Y=30.

```
#
```

**Notes**

(1) The target system operates in real time even when a GO command is executed after setting a BR condition.

(2) Each model has a different RAM area, and XY settings in a BR command can be set to FFF.

# BM, BMR *SET/RESET BREAK MULTIPLE CONDITION*

**Format**

**#BM↵** **(With guidance)**

**#BMR↵**

**Function**

Sets the compound break function for multiple breaks when all conditions for the evaluation board CPU PC, data RAM access, and register values coincide.

(1) Although the BA, BD and BR conditions can be set independently, the BM command generates a break when all conditions for the PC, data RAM access, and register values coincide. In other words, it can be thought of as the AND setting for the BA, BD and BR commands.

(2) Previously set BA, BD and BR conditions are canceled by the BM command. Also, the BM setting is canceled when the BA, BD and / or BR conditions are set after the BM condition is set.

(3) The BMR command cancels the BM condition.

(4) A break is set at only one point by the BM command. Each register setting can be masked.

**Examples**

```
#BM↵
 PC    ----:100↵      ...
 ADDR   ---:70↵
 DATA     -:A↵
 R/W      -:*↵
 A        -:*↵
 B        -:*↵
 FI       -:*↵
 FD       -:1↵
 FZ       -:*↵
 FC       -:1↵
 X      ---:*↵         ...
 Y      ---:3E↵
```

A hyphen (-) is displayed when a BM condition is canceled.
Break condition is set where PC=100, RAM access=70, RAM data=A, D and C flags=1, and Y register=3E.
During execution of the instructions at address 100, a break occurs when the following conditions coincide:
RAM at address 70 is accessed, read/write data A, FD and FC are set, and Y register is 3E. (Valid for break during program loop.)

The point at which the break is placed is masked by an asterisk (*) mark.

# *SET/RESET BREAK MULTIPLE CONDITION* BM, BMR

**Format**

**#BM↵** **(With guidance)**

**#BMR↵**

**Examples**

```
#BM↵
 PC     100:*↵          ...  PC mask
 ADDR    70:71↵
 DATA     A:^↵          ...  Enables return to previous operation when ^ key is entered
 ADDR    71:72↵
 DATA     A:↵           ...  Previous setting retained when ↵ alone is entered
 R/W      *:W↵
 A        *:↵
 B        *:↵
 FI       *:↵
 FD       1:↵
 FZ       *:↵
 FC       1:↵
 X        *:70↵
 Y       7E:↵
```

As shown above, a break is generated when data A is written to RAM address 72 if CPU register X=70, Y=7E, FD=1 and FC=1.

```
#BM↵
 PC       *:100↵
 ADDR    71:/↵          ...  Entering /↵ does not alter later settings; adds PC=100 to
                             above conditions
#BMR↵                   ...  Cancels condition set by BM command

#BM↵
 PC    ----:↵           ...  Entering ↵ after canceling BM setting confirms cancellation

#
```

**Notes**

(1) Use of the BM command automatically cancels BA, BD and BR commands.

(2) This instruction runs a break comparison only during execution with memory access. The above described limitations remain even when ADDR, data and R/W are masked. Therefore, a break will not occur when the instruction does not access data memory even if the PC and register values coincide.

(3) Each model has a different RAM area, and XY settings in a BM command can be set to FFF.

# BC *BREAK CONDITION DISPLAY*

**Format**

**#BC↵**

**Function**

Displays the current break condition.

**Examples**

```
#BC↵                              ...  Break condition is verified after power on. All break
 * BA NONE                             conditions are canceled.
 * BD NONE
 * BR NONE
 * BM NONE
 * BREAK ENABLE MODE              ...  Enters break enable mode
 * BREAK STOP MODE                ...  Enters break stop mode
 * TIME COUNT MODE                ...  Enters real-time mode

#BA,100,101↵

#BC↵                              ...  Reads after address break condition set Break condition
 * BA 0100..0101                       confirmed
 * BD NONE
 * BR NONE
 * BM NONE
 * BREAK ENABLE MODE
 * BREAK STOP MODE
 * TIME COUNT MODE

#BRES↵

#BA,100,102↵

#BC↵
 * BA 0100                        ...  Displays multiple executions of BA condition when
 * BA 0102                             addresses are not consecutive
  :

#
```

## *RESET ALL BREAK CONDITION* BRES

**Format**

**#BRES↵**

**Function**

All break conditions (BA, BD, BR, or BM settings) are canceled.

**Examples**

```
#BRES↵

#BC↵
 * BA NONE
 * BD NONE
 * BR NONE
 * BM NONE
 * BREAK ENABLE MODE
 * BREAK STOP MODE
 * TIME COUNT MODE

#
```

**Note**

Although the break condition is canceled, the break mode (enable / disable, trace, stop, time / stop) is still operative.

# G *GO TARGET PROGRAM*

**Format**

**#G**↵

**#G,** *<address >*↵

**#G,R**↵

**Function**

This instruction runs the target program. When a break condition is detected, program execution is halted and the break status is displayed to complete the instruction.

## ■ Setting the Starting Address

(1) When an <*address*> is entered, the run starts from that address.

(2) With an R setting the evaluation board CPU is reset, and the run starts from the reset address 0100.

(3) When the <*address*> and R setting are defaulted, the run starts from the current address (PC which displays the status during the previous break).
When G↵ is entered after power on, the run starts from address 0100, but the evaluation board CPU is not reset.

## ■ Break Mode and Break Condition

| Item | Break mode (note) | Break condition | Comments |
|---|---|---|---|
| 1 | Break enable mode<br>& break stop mode | * Reset switch<br>* Break switch<br>* Break set commands<br>(BA, BD, BR, BM)<br>* ESC input | Mode at power on. |
| 2 | Break enable mode<br>& break trace mode | * Reset switch<br>* Break switch<br>* ESC input | When the break condition and evaluation board CPU executed cycle coincide, the bleak status alone is displayed and the GO command is restarted. |
| 3 | BSYN mode<br>& break stop mode | * Reset switch<br>* Break switch<br>* ESC input | When the break condition and evaluation board CPU executed cycle coincide, a pulse is output to the SYNC pin. |

*Note: Refer to Section 2.3.2, "Break mode and break function" for more information on the break mode.*

# *GO TARGET PROGRAM* G

**Format**

**#G**↵

**#G,**<***address***>↵

**#G,R**↵

**Function**

## ■ Display During Execution of GO Instruction

| Item | Display mode (note) | Display method | |
|---|---|---|---|
| 1 | On-the-fly display mode | #G↵ | |
| | | *PC=xxxx... | Sampling of the PC is displayed about every 500 msec. HALT message is displayed during halt. |
| 2 | On-the-fly inhibit mode | #G↵ | Exection status is not displayed. |

*Note: Refer to Section 2.3.4, "Display during run mode and during break" for information on the display modes.*

## ■ Break Display

```
#G↵
 *PC=xxxx
 *EMULATION END STATUS = BREAK HIT          ... (A)
 *PC=0100 A=0 B=0 X=70 Y=00 F=ID.C SP=10    ... (B)
 *RUN TIME=xxx mS                           ... (C)
```

→ The break status is displayed.

(A) BREAK HIT, ESC KEY, BREAK SW displays appear in parts. When the reset switch is depressed, the message, *ICE6200 RESET SW TARGET*, is displayed without displaying the break status, and the next instruction is awaited.

(B) Register contents are displayed in part when PC (next executed address) is stopped.

(C) The execution time or executed number of steps set by TIM command are displayed in part. (Refer to the TIM command.)

# G *GO TARGET PROGRAM*

**Format**

**#G**↵

**#G,**<***address*** >↵

**#G,R**↵

**Examples**

```
#OTF↵                          ...  On-the-fly set command
 * ON THE FLY ON *

#BE↵                           ...  Break enable set command

 * BREAK ENABLE MODE *

#BT↵                           ...  Break stop mode set command
 * BREAK STOP MODE *

#G,R↵                          ...  Target and evaluation board is reset; run starts from
                                    reset address (0100)
 *PC=xxxx                      ...  PC display is cyclic
 *EMULATION END STATUS = BREAK HIT          ... (A)
 *PC=01FF A=5 B=0 X=70 Y=05 F=..ZC SP=20    ... (B)
 *RUN TIME=100mS                            ... (C)
```

These settings are set at power on; default is command input

(A) Break displayed through break condition (BA condition set at 01FE)

(B) F is expresses reset bit and (.) bit as English letter

(C) Run time is 100mS

```
#
```

# *SINGLE STEP TRACE* T

**Format**

**#T,<*address*>,<*step number*>↵**
**#T,<*address*>↵**
**#T,,<*step number*>↵**
**#T↵**

**Function**

Executes trace, and single step actions of programs.

(1) The specified portion of the target program executes with a frequency indicated by the <*step number*> from the specified <*address*> (65535 possible in decimal code). The PC, instruction word and register contents are displayed with each execution.

(2) When the <*step number*> is defaulted, only one step is executed.

(3) When the <*address*> is defaulted, the specified number of steps is executed from the current PC (PC at which the previous T command completed).

(4) When both <*address*> and <*step number*> are defaulted, only one step is executed from the current PC. When this setting occurs after power on, one step is executed from PC=0100.

(5) When the <*step number*> is one (#T, <*address*> or #T), the instruction does not terminate after one step, but a further step is executed by the "SP" key input, at which time the instruction can be terminated by the "ESC" key input.

(6) In (1) above, the instruction is terminated by "ESC" key input.

**Examples**

```
#T,100,3↵
 *PC=0100 IR=FFF NOP7      A=0 B=0 X=00F Y=00F F=IDZC SP=10
 *PC=0101 IR=E05 LD   A,5 A=5 B=0 X=00F Y=00F F=IDZC SP=10
 *PC=0102 IR=B05 ADC XH,5 A=5 B=0 X=051 Y=00F F=IDZC SP=10
#
```

- `*PC=0102` — Executed PC is displayed
- `IR=B05 ADC XH,5` — Command code and mnemonic are displayed
- `F=IDZC` — Correctors displayed when the flag is set and/or reset (After executing three steps, the current PC is 0103)

# T *SINGLE STEP TRACE*

**Format**

**#T,** <***address***>**,** <***step number***>↵
**#T,** <***address***>↵
**#T,,** <***step number***>↵
**#T**↵

**Examples**

#T↵ Program executes sequentially in steps from current PC (=103) via "SP" key.

```
 *PC=0103 IR=FDF RET       A=5 B=0 X=04F Y=03F F=IDZC SP=013 ... "SP"
 *PC=01AA IR=AD1 OR   A,B A=5 B=0 X=04F Y=03F F=ID.C SP=013 ... "ESC"
```

Instruction is terminated by "ESC" key.

#T↵

```
 *PC=01AB IR=xxx PSET  2 A=x B=x X=xxx Y=xxx F=xxxx SP=013
 *PC=01AC IR=xxx JP   10 A=x B=x X=xxx Y=xxx F=xxxx SP=013  ... "ESC"
```

# Because the PSET command is used in relation to the subsequent instruction, two command executions can be set by invoking the T command once.

#T↵

```
 *PC=01AD IR=xxx HALT _
                      └── Cursor
```

#

When the HALT command is executed by the T command, the command mnemonics are displayed until the target interrupt as described above, but the register value is not displayed. When an interrupt is properly input, the register is displayed and the next "SP" is awaited. The "SP" input restarts the program after the interrupt routine.
When the target interrupt never occurs, the instruction can be forced to terminate by using the "ESC" key. At that point, the HALT and T commands terminate, but the HALT command executes from the next address when the T command is operative.

**Notes**

(1) The T command does not operate in real time. Therefore, the target timer is renewed. (For details refer to Section 2.3.13, "Limitations during emulation".)

(2) When the H command is input after executing this command, the message, `*NO HISTORY DATA*`, is displayed. Therefore, the G command must be used to analyze history data.

## *SINGLE STEP TRACE & LAST INFORMATION DISPLAY* U

**Format**

**#U,<*address*>,<*step number*>↵**

**#U,,<*step number*>↵**

**Function**

Executes trace and single step actions of programs and indicates final results alone.

(1) The target program is executed from the address specified in <*address*> for the frequency specified in <*step number*> (65535 possible in decimal code), but the results are not displayed until after the final instruction is completed.

(2) When the <*address*> is defaulted, execution starts from the current PC for the specified number of steps.

**Examples**

```
#U,100,5↵
 *PC=01AA IR=ADI OR   A,B   A=5 B=0 X=04F T=03F F=ID.C SP=13

#U,,1↵
 *PC=01AB IR=FFF NOP7       A=5 B=0 X=04F Y=03F F=ID.C SP=13

#
```

**Notes**

(1) The U command does not run in real time, so the target timer is renewed. (For details refer to Section 2.3.13, "Limitations during emulation".)

(2) When the H command is input after executing this command, the message, *NO HISTORY DATA*, is displayed. Therefore, the G command must be used to analyze history data.

# BE, BSYN *BREAK ENABLE MODE SET/BREAK DISABLE & SYNC MODE SET*

**Format**

**#BE↵**

**#BSYN↵**

**Function**

Sets the break enable mode and break disable mode.

(1) BE: Sets the break enable mode. A break is generated when the BA, BD, BR or BM conditions coincide with the evaluation board CPU state.

(2) BSYN: Sets the break disable (synchronous) mode. When the BA, BD, BR or BM conditions coincide with the evaluation board CPU state, a pulse is output to the ICE SYNC pin and a break is not generated.

(3) At power on, the break enable mode is operative.

**Examples**

```
#BE↵
 * BREAK ENABLE MODE

#BSYN↵
 * BREAK DISABLE MODE
 * BREAK STOP MODE

#
```

**Note**

Refer to Section 2.3.2, "Break mode and break function", for details of break enable / disable functions.

# *BREAK TRACE MODE SET* BT

**Format**

**#BT↵** **(Toggle)**

**Function**

Selects the break stop mode or the break trace mode. Setting is reversed with each command input. At power on, the break stop mode is operative.

**Examples**

```
#BT↵
 * BREAK TRACE MODE      ...  Since the stop mode is operative at power on, the trace
 * BREAK ENABLE MODE           mode is set by command input

#BT↵
 * BREAK STOP MODE       ...  The setting is reversed by command input

#
```

**Note**

Refer to Section 2.3.2, "Break mode and break function", for details of break stop and trace modes.

# BRKSEL *BREAK ADDRESS MODE SELECT*

**Format**

**#BRKSEL,REM↵**

**#BRKSEL,CLR↵**

**Function**

After setting the break address condition (BA), the program runs until stopped by a break hit; the settings then remain or clear the previously set BA condition. The clear mode (CLR mode) is operative at power on. The BA condition remain mode (REM mode) is used when multiple break conditions are set and the program runs to consecutive break points. The BA condition clear mode (CLR mode) is used to debug when the break point is changed with each break.

**Examples**

```
#BA,0100↵

#BRKSEL,REM↵                                ...  Remain mode is set

#BC↵
 BA 0100
    :

#G↵
 *PC=100
 *EMULATION END STATUS = BREAK HIT  ...  Break is generated when break
 *RUN TIME=10mS                          condition hits

#BA,200↵                                    ...  New break condition is set

#BC↵
 BA 0100                                    ...  Pre-break condition remains
 BA 0200
    :

#BRKSEL,CLR↵                                ...  Clear mode is set

#G↵
 *PC=101
 *EMULATION END STATUS = BREAK HIT  ...  Break condition hits
 *RUN TIME=30mS

#BA,300↵                                    ...  New break condition is set

#BC↵
 BA 0300                                    ...  Pre-break condition is canceled
    :

#BA,350,3A0↵

#BC↵
 BA 0300                                    ...  After break condition remains
 BA 0350
 BA 03A0

#
```

## 3.4 File Command Group

# RF, RFD *READ PROGRAM/DATA FILE*

**Format**

**#RF,** <***file name***>↵

**#RFD,** <***file name***>↵

**Function**

Loads files onto the emulation memories.

(1) RF: The hex file specified in <*file name*> is loaded in the emulation program memory.

(2) RFD: The hex file (data RAM) specified in <*file name*> is loaded in the data memory.

**Examples**

```
#RF,C6200A0↵        ...  C6200A0H.HEX file and C6200A0L.HEX file are loaded
                         in the program memory
#RFD,WORK↵          ...  WORKD. HEX file is loaded in the data memory
#
```

**Notes**

(1) When the memory area is overreached (address 3FF in program memory; address 7E in data memory for S1C6S3N7/6S3B7/6S3L7) or an FD file format error is detected, an error message, `*FILE DATA FORMAT ERROR*`, is displayed and the instruction terminates. The contents of the emulation program memory and data memory are not secured.

(2) I/O memory, segment memory and unused area are not loaded into data memory.

(3) The files are in hexadecimal format. (For details, refer to appendix B.)

(4) The file format is created by the S1C62XXX cross assembler. (For details, refer to the Part III, "Cross Assembler ASM62XX".)

(5) "ESC" key is invalid during instruction execution.

(6) When an input error (FD error, not drive error) is detected on the PC side, control is returned to the operating system, and therefore, the ICS62XX is terminated.

(7) When an undefined instruction is detected, an error message is displayed and the ICS62XX program terminates. (For details, refer to Chapter 4.)

# *VERIFY PROGRAM/DATA FILE* VF, VFD

**Format**

**#VF,**<***file name***>↵

**#VFD,**<***file name***>↵

**Function**

Compares the contents of the emulation memories with those of files.

(1) VF: The contents of the emulation program memory and the hex file specified in <*file name*> are collated.

(2) VFD: The contents of the emulation data memory (data RAM) and the hex file specified in <*file name*> are collated.

**Examples**

```
#VF,C6200A0↵
 ADDR  FD:ICE
 0100 FFF:FFC
 0300 FFC:FFB

#VFD,DATA↵
 ADDR  FD:ICE
  001   1:3
 * ESC *

#
```

... C6200A0H.HEX and C6200A0L.HEX files and the program memory are collated

... The contents of the FD address and the memory are displayed only when the collated data do not agree.

... Display can be interrupted by "ESC" key input

**Notes**

(1) Notes (1), (3), (4) and (6) in page VIII-70 are applicable to these instructions.

(2) "ESC" key is valid during error message display; "ESC" key input terminates the instruction.

(3) I/O memory, segment memory and unused area in data memory cannot be compared.

# WF, WFD *WRITE PROGRAM/DATA FILE*

**Format**

**#WF,<*file name*>↵**

**#WFD,<*file name*>↵**

**Function**

Saves the contents of the emulation memories to files.

(1) WF: The contents of the emulation program memory are saved to the file specified in <*file name*>.

(2) WFD: The contents of the emulation data memory (data RAM) are saved to the file specified in <*file name*>.

**Examples**

```
#WF,C6200A0↵                ...  Program memory is saved to C6200A0H.HEX and
                                 C6200A0L.HEX files.
#WFD,WORK↵                  ...  Data memory is saved to WORKD.HEX file.

#WF,ABCDEFGH↵
 * COMMAND ERROR *          ...  An error occurs if the file name exceeds seven characters.

#
```

**Notes**

(1) Notes (3), (4), (5) and (6) of page VIII-70 are applicable to these commands.

(2) I/O memory, segment memory and unused area in data memory cannot be saved.

## *CONDITION LOAD/SAVE* CL, CS

**Format**

**#CL,** <*file name*>↵

**#CS,** <*file name*>↵

**Function**

Loads the contents of the emulation memories of ICE and the contents of each setting from files or save them to files.

(1) CL: The program and data from the file specified in <*file name*> are loaded into the program and data memories respectively. Each type of command set condition is loaded, also.

(2) CS: The contents of the current ICE emulation program memory and data memory as well as each command set condition (break state, etc.) are saved to the file specified in <*file name*>.

(3) The loaded and saved contents are as follows:
- Target program (emulation program)
- Target data (emulation data)
- Current register values of the evaluation board CPU (A, B, X, Y, F, SP, PC)
- Current break data (conditions set by BA, BD, BR and / or BM commands)
- Break mode data (execution time / steps, break stop / break trace, break enable / break SYNC, with / without on-the-fly).

(4) These instructions are valid when power is switched off and reapplied.

**Examples**

```
#CS,TEST↵          ...  Current ICE set conditions are saved to the TESTC.HEX file;
    :                   contents of emulation program memory are saved to the TESTH.HEX
                        file, while contents of data memory are saved to the TESTD.HEX file
Power OFF
Power ON
    :
#CL,TEST↵          ...  Contents saved in CS are loaded; ICE returns to the status prior to
                        power OFF
#
```

**Notes**

(1) Notes (1), (2), (3), (4), (5), and (6) of page VIII-70 are applicable to these commands.

(2) A file name of up to seven characters may be specified as <*file name*> for #CS, <*file name*>.

# OPTLD *READ HEXA DATA FILE*

**Format**

**#OPTLD,0,**<***file name***>↵

**Function**

Load melody HEX files in the evaluation board melody data memory.
These are HEX files output by the melody assembler and have intel HEX format.

**Example**

```
#OPTLD,0,C2XXYYY↵  ...  C2XXYYY.HEX files are loaded in the melody data memory.

#
```

## 3.5 ROM Command Group

# RP *LOAD ROM PROGRAM*

**Format**

**#RP↵**

**Function**

The program is loaded to the ICE emulation memory from the ROM at the ICE ROM socket (high and low). The FF ROM data is unassembled.

**Examples**

```
#RP↵
 * NO ROM H/L *          ...   Error is generated because high and low ROM are
                                unassembled
#RP↵
 * NO ROM H *            ...   Error generated because high side ROM is unassembled

#RP↵
                         ...   Contents of ROM are properly loaded
#
```

**Notes**

(1) Refer to the ROM command for information on the valid loading region.

(2) When undefined code is detected, the ICS62XX program is terminated and control returns to the operating system.

# *VERIFY ROM PROGRAM* VP

**Format**

**#VP**↵

**Function**

The contents of the ICE ROM socket (high and low) and the ICE emulation memory are compared. When they do not agree, the data contents are displayed.

**Examples**

```
#VP↵
#
 :
```

When the results of the comparison are acceptable, the program execution is at waiting until ordering the next instruction

```
#VP↵
 ADDR ROM:ICE
 0100 FFF:FFC    ...
 0300 0FF:0FC
  :    :   :
 03FF 000:001
```

All non-agreeing data (ROM address, ROM contents, emulation memory contents) are displayed

```
#VP↵
 * NO ROM H *    ...
```

Error because high side ROM is unassembled

```
#VP↵
 ADDR ROM:ICE
 0100 FFF:FFC
 0300 0FF:0FC
  :    :   :
 * ESC *         ...
#
```

Processing is interrupted by "ESC" key input, and the program execution is at waiting until entering the next command

# ROM *ROM TYPE SELECT*

**Format**

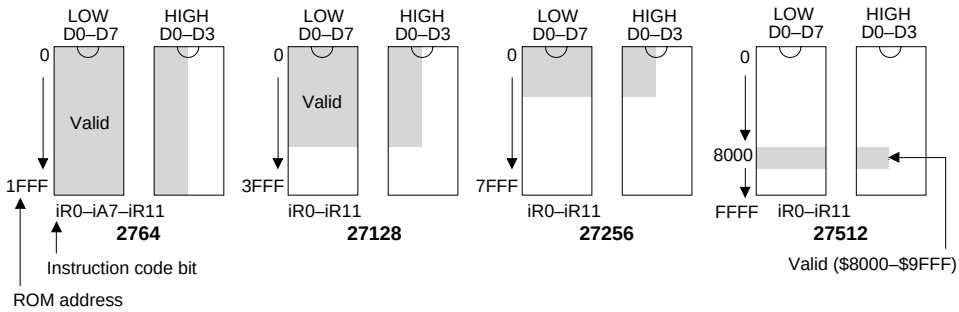
**#ROM↵** **(With guidance)**

**Function**

The ROM type which is assembled to the ICE ROM socket is set.

(1) 2764, 27128, 27256 or 27512 can be selected.

(2) The region to which the ROM type is loaded is described below.




**Examples**

```
#ROM↵
 *ROM 64:↵
```
. . . Initial value set at 64
When ↵ input alone is entered without modification of data, the execution is at waiting until entering the next command

```
#ROM↵
 *ROM 64:256↵
```
. . . Setting changed to 27256

```
#ROM↵
 *ROM 256:FF↵
 * COMMAND ERROR *
```
. . . Setting other than 64, 128, 256 or 512 results in an error

```
#ROM↵
 *ROM 256:↵

#
```

**Note**

ROM which is assembled to the high and low IC sockets should be the same types.

## 3.6 Control Command Group

## *INITIALIZE TARGET CPU*

**Format**

**#I↵**

**Function**

Resets the evaluation board CPU.
Resets the evaluation board CPU, but the ICE set conditions (break, etc.) are affected.

**Example**

#I↵

| | |
|---|---|
| # | The execution is at waiting until entering the next command |

## *TIME OR STEP MODE SELECTION* TIM

**Format**

**#TIM↵** **(Toggle)**

**Function**

When the GO command is entered, the execution time counter, execution time count mode or step count mode is operative. The execution time count mode is the default at power on. The setting is reversed at each command input.

**Examples**

```
#TIM↵
 * STEP COUNT MODE    ...  Since the mode after power supply is the time count mode,
                           entering a command toggles the setting to step mode
#TIM↵
 * TIME COUNT MODE    ...  Setting is reversed with each command input

#
```

**Note**

Refer to Section 2.3.10, "Measurement during command execution", for more details on the time count and step count modes.

# OTF *ON THE FLY MODE SET*

**Format**

**#OTF↵** **(Toggle)**

**Function**

Selects whether or not to run the on-the-fly display during GO execution.
On-the-fly display mode is the default at power on. Use the display off mode when the host is connected to a printer.

**Examples**

```
#OTF↵
 * ON THE FLY OFF          ...  Since the display mode is the default at power on,
                                a command input toggles to the display off mode
#OTF↵
 * ON THE FLY ON           ...  On-the-fly display mode is operative

#G↵
 * PC=xxxx                 ...  Displays fixed cycle of evaluation board CPU's
                                executed PC
   :

#OTF↵
 * ON THE FLY OFF

#G↵
                           ...  PC is not displayed
#
```

**Note**

For more details about the on-the-fly function, refer to Section 2.3.4, "Display during run mode and during break".

## *QUIT* Q

**Format**

**#Q↵**

**Function**

Terminates the ICS62XX program and returns control to the operating system.

**Example**

```
#Q↵

B>                          ...  A waits control by host computer operating system

B>ICS62XX↵                  ...  Reloads the ICE
... Epson logo is displayed for about one second ...
 * ICE POWER ON RESET *
 * DIAGNOSTIC TEST OK *

#                           ...  A waits ICE instruction
```

## *3.7 HELP Command*

# HELP

**Format**

**#HELP↵** **(With guidance)**

**#HELP,n↵** **(n=1 to 8)**

**Function**

Displays the ICS62XX commands.

(1) All commands are displayed on a single screen when no option (,n) is set.

(2) Displays the related commands when an option (,n) is set.
Explanations for commands of the same group are displayed.

| n value | Command group |
|---|---|
| 1 | DISPLAY COMMAND |
| 2 | SET COMMAND |
| 3 | BREAK & GO COMMAND |
| 4 | FILE COMMAND |
| 5 | ROM COMMAND |
| 6 | CONTROL COMMAND |
| 7 | ALL COMMAND DISPLAY |
| 8 | BASIC COMMAND DISPLAY |

**Examples**

```
#HELP↵
```

Refer to HELP messages on next page

```
KEY IN 1.8 ENTER OR ENTER ONLY : 1↵
```

Displays DISPLAY COMMAND
(Refer to next page)

```
#HELP,F↵                    ...  Error is generated if a value other than 1 to 8 is entered
 * COMMAND ERROR *

#
```

# HELP

**Format**

**#HELP↵** **(With guidance)**

**#HELP,n↵** **(n=1 to 8)**

**Examples**

```
#HELP↵
 1.DISPLAY COMMAND           #L   #DP  #DD  #DR  #H   #HB  #HG  #HS  #HSW #HSR
                             #HP  #CHK #DXY #CVD #HAD
 2.SET COMMAND               #A   #FP  #FD  #MP  #MD  #SP  #SD  #SR  #SXY #HC
                             #HA  #HAR #HPS #CVR
 3.BREAK and GO COMMAND      #BA  #BD  #BR  #BM  #BAR #BDR #BRR #BMR #BRES
                             #BC  #G   #T   #U   #BSYN #BE #BT  #BRKSEL
 4.FILE COMMAND              #RF  #VF  #WF  #RFD #VFD #WFD #CL  #CS  #OPTLD
 5.ROM COMMAND               #RP  #VP  #ROM
 6.CONTROL COMMAND           #I   #TIM #OTF #Q
 7.ALL COMMAND DISPLAY
 8.BASIC COMMAND DISPLAY

 KEY IN 1..8 ENTER or ENTER ONLY :↵
#

#HELP,1↵
 1.DISPLAY COMMAND
 (1)#L,addr1,addr2   program code and mnemonic display.
 (2)#DP,addr1,addr2  program area HEX display.
 (3)#DD,addr1,addr2  data area HEX display.
 (4)#DR              register data display.
 (5)#H,addr1,addr2   history data display.
 (6)#HB or #HG       history data display BACK or GO NEXT.
 (7)#HS,addr         history serch and display.
 (8)#HSW,addr        memory write history serch and display.
 (9)#HSR,addr        memory read history serch and display.
(10)#HP              current history pointer display.
(11)#CHK             ice initial self test information display.
(12)#DXY             X,Y register and MX,MY data display.
(13)#CVD,addr1,addr2 coverage area display.
(14)#HAD             history PC area information display.

#
```

# HELP

**Format**

**#HELP↵** **(With guidance)**

**#HELP,n↵** **(n=1 to 8)**

**Examples**

```
#HELP,2↵
 2.SET COMMAND
 (1)#A,addr                assemble program.
 (2)#FP,addr1,addr2,data   fill program addr1 to addr2 by data.
 (3)#FD,addr1,addr2,data   fill data addr1 to addr2 by data.
 (4)#MP,addr1,addr2,addr3  move program from addr1..addr2 to addr3.
 (5)#MD,addr1,addr2,addr3  move data from addr1..addr2 to addr3.
 (6)#SP,addr               program area patch.
 (7)#SD,addr               data area patch.
 (8)#SR or #SR,reg,data    register patch.
 (9)#SXY                   MX,MY patch.
(10)#HC,S/C/E              history Start/Center/End set.
(11)#HA,addr1,addr2        set PC addr1..addr2 save to history memory.
     (#HA,ALL)             (all data save.)
(12)#HAR,addr1,addr2       inhibit PC addr1..addr2 save to history memory.
     (#HAR,ALL)            (all reset.)
(13)#HPS,addr              set history pointer.
(14)#CVR                   reset coverage information.

#

#HELP,3↵
 3.BREAK and GO COMMAND
 (1)#BA,addr,...    set break address.
 (2)#BD             set break data condition.
 (3)#BR             set break register condition.
 (4)#BM             set break address,data,register multiple condition.
 (5)#BAR            reset break address.
 (6)#BDR            reset break data condition.
 (7)#BRR            reset break register condition.
 (8)#BMR            reset break address,data,register multiple condition.
 (9)#BRES           reset all break condition.
(10)#BC             break condition display.
(11)#G or #G,addr   GO current address or GO from set addr.
(12)#G,R            GO after reset cpu.
(13)#T,addr,step    single step run and display break information.
(14)#U,addr,step    single step run in ICE. and display last break information.
(15)#BSYN           set break disable mode.
(16)#BE             set break enable mode.
(17)#BT             set and reset break trace made. (alternate)
(18)#BRKSEL,CLR/REM set break address clear mode or remain mode.

#
```

# HELP

**Format**

**#HELP↵** **(With guidance)**

**#HELP,n↵** **(n=1 to 8)**

**Examples**

```
#HELP,4↵
 4.FILE COMMAND
 (1)#RF,file                program load.
 (2)#VF,file                program verify.
 (3)#WF,file                program save.
 (4)#RFD,file               RAM data load.
 (5)#VFD,file               RAM data verity.
 (6)#WFD,file               RAM data save.
 (7)#CL,file                program,RAM data,break condition load.
 (8)#CS,file                program,RAM data,break condition save.
 (9)#OPTLD,option no.,file  HEXA data load.
#

#HELP,5↵
 5.ROM COMMAND
 (1)#RP       program load from ROM.
 (2)#VP       program verify ice:ROM.
 (3)#ROM      ROM type select. (64,128,256,512)
#

#HELP,6↵
 6.CONTROL COMMAND
 (1)#I        reset target CPU.
 (2)#TIM      set step count mode or time count mode. (alternate)
 (3)#OTF      set on-the-fly display mode or inhibit mode. (alternate)
 (4)#Q        program exit.
#

#HELP,8↵
 8.BASIC COMMAND
 (1)#L,addr1,addr2   program code and mnemonic display.
 (2)#DD,addr1,addr2  data area HEX display.
 (3)#DR              register data display.
 (4)#BC              break condition display.
 (5)#H,addr1,addr2   history data display.
 (6)#A,addr          assemble program.
 (7)#SP,addr         program area patch.
 (8)#SD,addr         data area patch.
 (9)#SR              register patch.
(10)#BA,addr,...     set break address.
(11)#BD              set break data condition.
(12)#BR              set break register condition.
(13)#BM              set break address,data,register multiple condition.
(14)#BRES            reset all break condition.
(15)#G or #G,addr    GO current address or GO from set address.
(16)#T,addr,step     single step run and display break information.
(17)#CL,file         program,RAM data,break condition load.
(18)#CS,file         program,RAM data,break condition save.
(19)#I               reset target CPU.
(20)#Q               program exit.
#
```

# 4 ERROR MESSAGE SUMMARY

***Error message:*** **`* COMMUNICATION ERROR OR ICE NOT READY *`**
***Meaning:*** ICE is disconnected or power is OFF.
***Recovery procedure:*** Switch OFF the host power supply, connect cable, and reapply power. Or switch ON power to ICE.

***Error message:*** **`* TARGET DOWN(1) *`**
***Meaning:*** Evaluation board is disconnected. (Check at power ON)
***Recovery procedure:*** Switch OFF power to ICE, and connect the evaluation board. Then, apply power to ICE.

***Error message:*** **`* TARGET DOWN(2) *`**
***Meaning:*** Evaluation board disconnected. (Check at command execution)
***Recovery procedure:*** Switch OFF power to ICE, and connect the evaluation board. Then, apply power to ICE.

***Error message:*** **`* UNDEFINED PROGRAM CODE EXIST *`**
***Meaning:*** Undefined code is detected in the program loaded from ROM. (ICE program terminates)
***Recovery procedure:*** Convert ROM data with the S1C62XXX cross assembler, then restart the ICE.

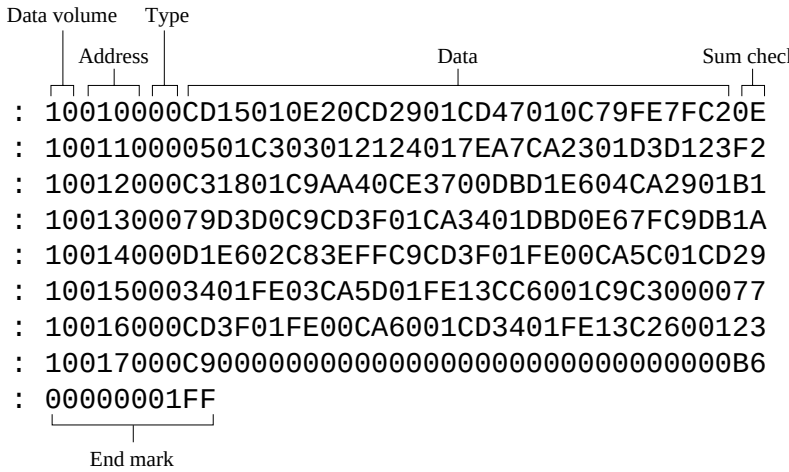
***Error message:*** **`* COMMAND ERROR *`**
***Meaning:*** A miss occurs by command input.
***Recovery procedure:*** Reenter the proper command.

***Error:*** **`No response after power on.`**
***Meaning:*** The ICE-to-HOST cable is disconnected on the host side.
***Recovery procedure:*** Connect the cable.

# *APPENDIX. HEX FILE FORMAT*

## ■ Description of HEX file format

Example:




- **Data volume (1 byte):** Indicates the quantity of data contained in the data area. Maximum capacity is 10H (sixteen entries).
- **Address (2 bytes):** Indicates the top line of data at each address.
- **Type (1 byte):** Indicates the type of hexadecimal format, currently only 00.
- **Data (16 bytes max.):** Data is shown in hexadecimal format.
- **Sum check (1 byte):** Two complements resulting from adding all bytes from "data volume bytes" to "final data byte" are expressed as hexadecimal values.
- **End mark:** Required to mark the end of the hex file.

# IX

## MASK DATA CHECKER

# MDC62XX

This part explains how to operate the MDC62XX Mask Data Checker for the S1C62 Family.

# MASK DATA CHECKER MDC62XX

## Contents

# 1 DIFFERENCES DEPENDING ON THE MODEL

Depending on the model, the MDC62XX input / output file and the below two types of files in the program that prepares the file may not be available.

(1) The SOG62XX and C2XXYYYS.DOC are only set in models that have the segment option.
(2) The MLA628X and C28XYYYA.DOC are only set in models that have the melody function.

When models that do not have the above functions are used, disregard the respectively below indicated program names and data file names.
Refer to the "S5U1C62xxxD Manual" for the software tools included in the S5U1C62xxxD.

# 2 MDC62XX OUTLINE

## 2.1 Outline

The Mask Data Checker MDC62XX is a software tool which checks the program data (C2XXYYYH.HEX and C2XXYYYL.HEX), option data (C2XXYYYF.DOC and C2XXYYYS.DOC), and melody data (C28XYYYA.DOC) created by the user and creates the data file (C62XXYYY.PAn) for generating mask patterns. The user must send the file generated through this software tool to Seiko Epson.

Moreover, MDC62XX has the capability to restore the generated data file (C62XXYYY.PA0) to the original file format (C2XXYYYH.HEX, C2XXYYYL.HEX, C2XXYYYF.DOC, C2XXYYYS.DOC and C28XYYYA.DOC).

## 2.2 Execution Flow and Input/Output Files

The execution flow for MDC62XX is shown in Figure 2.2.1.

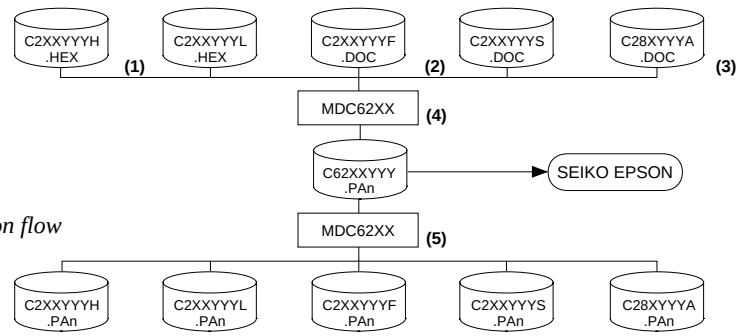



*Fig. 2.2.1 MDC62XX execution flow*

**(1) Preparation of program data files (C2XXYYYH.HEX and C2XXYYYL.HEX)**

Prepare the program data files generated from the Cross Assembler (ASM62XX).

**(2) Preparation of option data files (C2XXYYYF.DOC and C2XXYYYS.DOC)**

Prepare the option data files (function option and segment option) generated from the Option Generator (FOG62XX and SOG62XX).

**(3) Preparation of melody data file (C28XYYYA.DOC)**

Prepare the melody data file generated from the Melody Assembler (MLA628X).

**(4) Packing of data**

Using the Mask Data Checker (MDC62XX), compile the program data, option data and melody data in one mask data file (C62XXYYY.PAn). This file must be sent to Seiko Epson.

**(5) Unpacking of data**

The mask data file (C62XXYYY.PAn) may be restored to the original program data, option data and melody data files using the Mask Data Checker (MDC62XX).

# 3 MASK DATA CHECKER OPERATION

## 3.1 Copying the Data File

When submitting data to Seiko Epson, copy on the work disk the data generated from Cross Assembler (ASM62XX), Function Option Generator (FOG62XX), Segment Option Generator (SOG62XX) and Melody Assembler (MLA628X).

Be sure to assign the following file names (the YYY portion of the file name should be as designated by Seiko Epson):

- **Program data** (HIGH side): C2XXYYYH.HEX
  (LOW side): C2XXYYYL.HEX
- **Option data** (function option): C2XXYYYF.DOC
  (segment option): C2XXYYYS.DOC
- **Melody data** (melody ROM, scale ROM, melody option): C28XYYYA.DOC

## 3.2 Execution of MDC62XX

### 3.2.1 Starting MDC62XX

To start MDC62XX, insert the work disk into the current drive at the DOS command level (state in which a prompt such as A> is displayed) and then enter the program name as follows:

```
A>MDC62XX ↵
```

* ↵ *means press the return key.*

When starting MDC62XX through the DMS6200, selects the "MDC62XX.EXE" in the menu screen.

When MDC62XX is started, the following message is displayed:

```
                *** E0C62XX PACK / UNPACK PROGRAM Ver 1.00 ***

 EEEEEEEEEE    PPPPPPPP          SSSSSSS         OOOOOOOO       NNN      NNN
 EEEEEEEEEE    PPPPPPPPPP      SSS    SSSS     OOO    OOO      NNNN     NNN
 EEE           PPP     PPP    SSS      SSS    OOO      OOO     NNNNN    NNN
 EEE           PPP     PPP     SSS             OOO      OOO     NNNNNN   NNN
 EEEEEEEEEE    PPPPPPPPPP       SSSSSS        OOO      OOO     NNN NNN NNN
 EEEEEEEEEE    PPPPPPPP            SSSS       OOO      OOO     NNN  NNNNNN
 EEE           PPP                   SSS     OOO      OOO     NNN   NNNNN
 EEE           PPP              SSS    SSS    OOO      OOO     NNN    NNNN
 EEEEEEEEEE    PPP              SSSS   SSS     OOO    OOO      NNN     NNN
 EEEEEEEEEE    PPP                SSSSSSS       OOOOOOOO       NNN      NN

               (C) COPYRIGHT 1991 SEIKO EPSON CORPORATION

                       --- OPERATION MENU ---

                              1. PACK
                              2. UNPACK

                       PLEASE SELECT NO.? 1
```

Here, the user is prompted to select operation options. When creating mask data for submission to Seiko Epson, select "1"; when the mask data is to be split and restored to the original format (C2XXYYYH.HEX, C2XXYYYL.HEX, C2XXYYYF.DOC, C2XXYYYS.DOC and C28XYYYA.DOC), select "2".

### *3.2.2 Packing of data*

When generating data for submission to Seiko Epson, selecting "1" in the above Section, "Starting MDC62XX" will prompt for the name of the file to be generated as follows:

```
      C2XXYYYH.HEX ------+
                         |
      C2XXYYYL.HEX ------+
                         |
      C2XXYYYF.DOC ------+------ C2XXYYY.PAn (PACK FILE)
                         |
      C2XXYYYS.DOC ------+
                         |
      C28XYYYA.DOC ------+

PLEASE INPUT PACK FILE NAME (C62XXYYY.PAn) ?   C62XXYYY.PA0 ↵
```

The YYY portion is as specified for the user by Seiko Epson. Moreover, after submitting the data to Seiko Epson and there is a need to re-submit the data for reasons such as faulty programs, etc., increase the numeric value of "n" by one when the input is made. *(Example: When re-submiting data after "C62XXYYY.PA0" has been submitted, the pack file name should be entered as "C62XXYYY.PA1".)*

When data is packed, there is need to create ROM data file and option data file in the work disk beforehand.

When the file name has been input, mask data is generated and the corresponding file names are displayed.

```
      C2XXYYYH.HEX ------+
                         |
      C2XXYYYL.HEX ------+
                         |
      C2XXYYYF.DOC ------+------ C2XXYYY.PA0
                         |
      C2XXYYYS.DOC ------+
                         |
      C28XYYYA.DOC ------+
```

With this, the mask file (C62XXYYY.PAn) is generated. Submit this file to Seiko Epson.

*Note Don't use the data generated with the -N option of the Cross Assembler (ASM62XX) as program data. If the program data generated with the -N option of the Cross Assembler is packed, undefined program area is filled with FFH code.*
*In this case, following message is displayed.*

```
     WARNING: FILLED <file_name> FILE WITH FFH.
```

### *3.2.3 Unpacking of data*

In the process of restoring the packed data to the original file, when "2" is selected in the step described in "Starting MDC62XX", the user is prompted for the input file name as follows:

```
   PLEASE INPUT PACKED FILE NAME (C62XXYYY.PAn) ? C62XXYYY.PA0↵
```

When the file name has been entered, the unpacking process is executed and the corresponding file names are displayed.

```
                         +------ C2XXYYYH.PA0
                         |
                         +------ C2XXYYYL.PA0
                         |
      C62XXYYY.PA0 ------+------ C2XXYYYF.PA0
                         |
                         +------ C2XXYYYS.PA0
                         |
                         +------ C28XYYYA.PA0
```

With this, the mask data file (C62XXYYY.PAn) is restored to the original file format, making it possible to make comparison with the original data.

The restored data file names will be as follows:

- **Program data** (HIGH side): C2XXYYYH.PAn
  (LOW side): C2XXYYYL.PAn
- **Option data** (function option): C2XXYYYF.PAn
  (segment option): C2XXYYYS.PAn
- **Melody data** (melody ROM, scale ROM, melody option): C28XYYYA.PAn

# 4 ERROR MESSAGES

## 4.1 Data Error

The program data file and option data file and melody data file are checked during packing; the packed data file is checked during unpacking.
If there are format problems, the following error messages are displayed.

### 4.1.1 Program data error

| Error Message | Explanation |
|---|---|
| 1. HEX DATA ERROR : NOT COLON. | There is no colon. |
| 2. HEX DATA ERROR : DATA LENGTH. (NOT 00-20h) | The data length of 1 line is not in the 00–20H range. |
| 3. HEX DATA ERROR : ADDRESS. | The address is beyond the valid range of the program, melody and scale ROM. |
| 4. HEX DATA ERROR : RECORD TYPE. (NOT 00) | The record type of 1 line is not 00. |
| 5. HEX DATA ERROR : DATA. (NOT 00-FFh) | The data is not in the range between 00H and 0FFH. |
| 6. HEX DATA ERROR : TOO MANY DATA IN ONE LINE. | There are too many data in 1 line. |
| 7. HEX DATA ERROR : CHECK SUM. | The checksum is not correct. |
| 8. HEX DATA ERROR : END MARK. | The end mark is not : 00000001FF. |
| 9. HEX DATA ERROR : DUPLICATE. | There is duplicate definition of data in the same address. |

### 4.1.2 Function option data error

| Error Message | Explanation |
|---|---|
| 1. OPTION DATA ERROR : START MARK. | The start mark is not "\OPTION". (during unpacking) * |
| 2. OPTION DATA ERROR : OPTION NUMBER. | The option number is not correct. |
| 3. OPTION DATA ERROR : SELECT NUMBER. | The option selection number is not correct. |
| 4. OPTION DATA ERROR : END MARK. | The end mark is not "\\END" (packing) or "\END" (unpacking).* |

* \ sometimes appears as ¥, depending on the personal computer being used.

### 4.1.3 Segment option data error

| Error Message | Explanation |
|---|---|
| 1. SEGMENT DATA ERROR : START MARK. | The start mark is not "\SEGMENT". (during unpacking) * |
| 2. SEGMENT DATA ERROR : DATA. | The segment data is not correct. |
| 3. SEGMENT DATA ERROR : SEGMENT NUMBER. | The SEG No. is not correct. |
| 4. SEGMENT DATA ERROR : SPEC. | The output specification of the SEG terminal is not correct. |
| 5. SEGMENT DATA ERROR : END MARK. | The end mark is not "\\END" (packing) or "\END" (unpacking).* |

* \ sometimes appears as ¥, depending on the personal computer being used.

## 4.2 File Error

| Error Message | Explanation |
|---|---|
| 1. <File_name> FILE IS NOT FOUND. | The file is not found or the file number set in CONFIG.SYS is less than 10. |
| 2. PACK FILE NAME (File_name) ERROR. | The packed input format for the file name is wrong. |
| 3. PACKED FILE NAME (File_name) ERROR. | The unpacked input format for the file name is wrong. |

## 4.3 System Error

| Error Message | Explanation |
|---|---|
| 1. DIRECTORY FULL. | The directory is full. |
| 2. DISK WRITE ERROR. | Writing on the disk is failed. |

# 5 PACK FILE CONFIGURATION

The pack file is configured according to the following format:

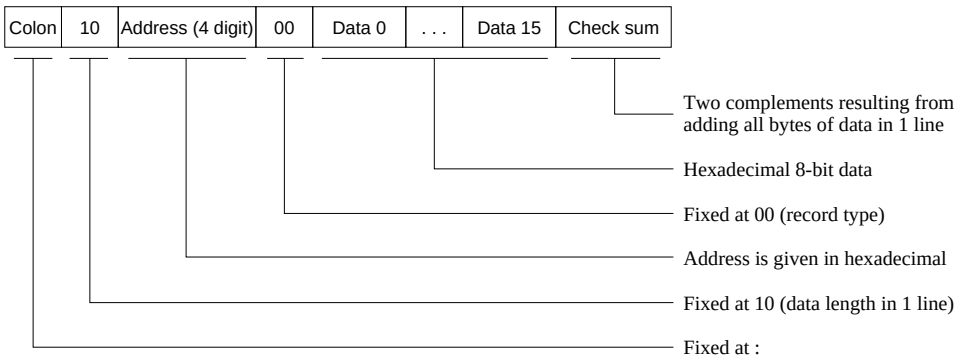
```
                          *
                          * E0C62XX MASK DATA VER 1.00
                          *
Program Data Header       — \ROM1
Model Name                — E0C62XXYYY  PROGRAM ROM
                          ┌ :100000000.............................
Program Data              │ :100010000.............................
 High Side (Intel Hexa Format) │    :    :    :    :    :    :    :
                          └ :00000001FF
                          ┌ :100000000.............................
Program Data              │ :100010000.............................
 Low Side (Intel Hexa Format) │    :    :    :    :    :    :    :
                          └ :00000001FF
End Mark                  — \END
Melody ROM Header         — \ROM2
Model Name                — E0C628XYYY  MELODY ROM
                          ┌ :100000000.............................
Melody ROM Data           │    :    :    :    :    :    :    :
 High Side (Intel Hexa Format) └ :00000001FF
                          ┌ :10000000..............................
Melody ROM Data           │    :    :    :    :    :    :    :
 Low Side (Intel Hexa Format) └ :00000001FF
End Mark                  — \END
Melody Scale ROM Header   — \ROM3
Model Name                ┌ E0C628XYYY  SCALE ROM
Melody Scale ROM Data     │ :10000000..............................
 (Intel Hexa Format)      └ :00000001FF
End Mark                  —  \END
Melody Option Data Header —  \OPTION1
                          ┌ *
                          │ *     OCTAVE CIRCUIT
Melody Option Data        │ *      32kHz ---------------------------- SELECTED
                          │  OPT2001 01
                          │    :    :    :    :    :    :    :    :
                          └  OPT2104 04
End Mark                  —  \END
Function Option Header    —  \OPTION2
                          ┌ * E0C62XX FUNCTION OPTION DOCUMENT  VER 3.00
                          │ *
                          │ * FILE NAME    C2XXYYYF.DOC
                          │ * USER'S NAME  SEIKO EPSON CORP.
                          │ * INPUT DATE   91/07/22
Function Option Data      │ *
                          │ * OPTION NO.1
                          │ * < DEVICE TYPE >
                          │ *     E0C62XX  ( NORMAL TYPE )  --------- SELECTED
                          │  OPT0101 01
                          └    :    :    :    :    :    :    :    :    :
End Mark                  — \END
Segment Option Header     —  \SEGMENT
                          ┌ * E0C62XX SEGMENT OPTION DOCUMENT VER 3.00
                          │ *
                          │ * FILE NAME    C2XXYYYS.DOC
                          │ * USER'S NAME  SEIKO EPSON CORP.
                          │ * INPUT DATE   91/07/22
                          │ * COMMENT      TOKYO DESIGN CENTER
                          │ *              421-8 HINO HINO-SHI TOKYO 191 JAPAN
Segment Option Data       │ *
                          │ *
                          │ * OPTION NO.xx
                          │ *
                          │ * < LCD SEGMENT DECODE TABLE >
                          │ *
                          │ * SEG COM0 COM1 COM2 COM3
                          │ *
                          │    0  ...  ...  ...  ...  S
                          │    1  ...  ...  ...  ...  C
                          └    :   :    :    :    :
End Mark                  — \END
```

* \ sometimes appears as ¥, depending on the personal computer being used.

## 5.1 Program Data, Melody ROM Data and Scale ROM Data

The program data, melody ROM data and scale ROM data are expressed as follows, using Intel hexa format:

### ■ Data line

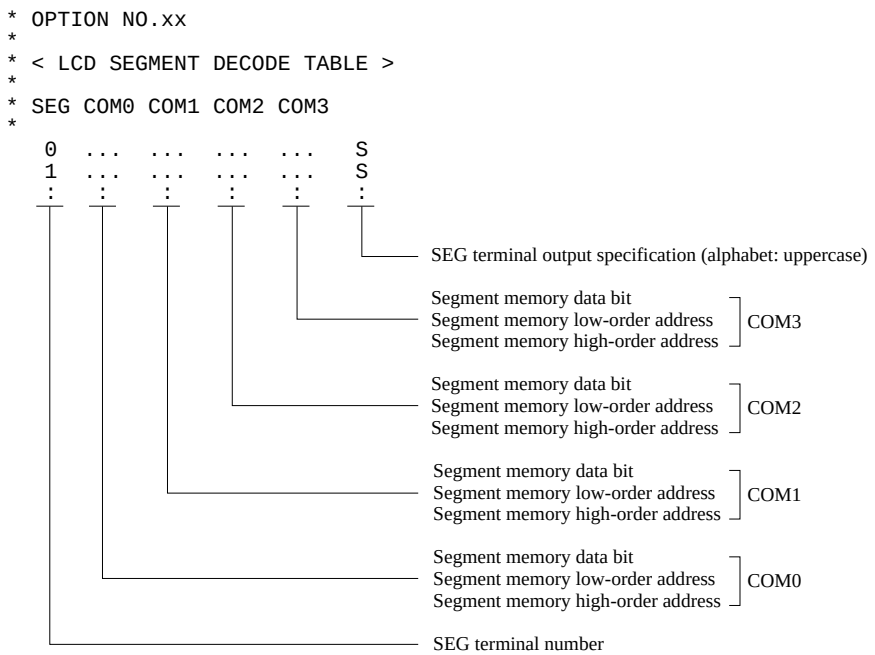



### ■ End mark

: 00000001FF

## 5.2 Segment Data

Segment data is configuerd according to the following format:



# EPSON International Sales Operations

## AMERICA

**EPSON ELECTRONICS AMERICA, INC.**

**- HEADQUARTERS -**
150 River Oaks Parkway
San Jose, CA 95134, U.S.A.
Phone: +1-408-922-0200 Fax: +1-408-922-0238

**- SALES OFFICES -**

**West**
1960 E. Grand Avenue
El Segundo, CA 90245, U.S.A.
Phone: +1-310-955-5300 Fax: +1-310-955-5400

**Central**
101 Virginia Street, Suite 290
Crystal Lake, IL 60014, U.S.A.
Phone: +1-815-455-7630 Fax: +1-815-455-7633

**Northeast**
301 Edgewater Place, Suite 120
Wakefield, MA 01880, U.S.A.
Phone: +1-781-246-3600 Fax: +1-781-246-5443

**Southeast**
3010 Royal Blvd. South, Suite 170
Alpharetta, GA 30005, U.S.A.
Phone: +1-877-EEA-0020 Fax: +1-770-777-2637

## EUROPE

**EPSON EUROPE ELECTRONICS GmbH**

**- HEADQUARTERS -**
Riesstrasse 15
80992 Munich, GERMANY
Phone: +49-(0)89-14005-0 Fax: +49-(0)89-14005-110

**SALES OFFICE**
Altstadtstrasse 176
51379 Leverkusen, GERMANY
Phone: +49-(0)2171-5045-0 Fax: +49-(0)2171-5045-10

**UK BRANCH OFFICE**
Unit 2.4, Doncastle House, Doncastle Road
Bracknell, Berkshire RG12 8PE, ENGLAND
Phone: +44-(0)1344-381700 Fax: +44-(0)1344-381701

**FRENCH BRANCH OFFICE**
1 Avenue de l' Atlantique, LP 915 Les Conquerants
Z.A. de Courtaboeuf 2, F-91976 Les Ulis Cedex, FRANCE
Phone: +33-(0)1-64862350 Fax: +33-(0)1-64862355

**BARCELONA BRANCH OFFICE**

**Barcelona Design Center**
Edificio Prima Sant Cugat
Avda. Alcalde Barrils num. 64-68
E-08190 Sant Cugat del Vallès, SPAIN
Phone: +34-93-544-2490 Fax: +34-93-544-2491

## ASIA

**EPSON (CHINA) CO., LTD.**
28F, Beijing Silver Tower 2# North RD DongSanHuan
ChaoYang District, Beijing, CHINA
Phone: 64106655 Fax: 64107319

**SHANGHAI BRANCH**
4F, Bldg., 27, No. 69, Gui Jing Road
Caohejing, Shanghai, CHINA
Phone: 21-6485-5552 Fax: 21-6485-0775

**EPSON HONG KONG LTD.**
20/F., Harbour Centre, 25 Harbour Road
Wanchai, Hong Kong
Phone: +852-2585-4600 Fax: +852-2827-4346
Telex: 65542 EPSCO HX

**EPSON TAIWAN TECHNOLOGY & TRADING LTD.**
10F, No. 287, Nanking East Road, Sec. 3
Taipei
Phone: 02-2717-7360 Fax: 02-2712-9164
Telex: 24444 EPSONTB

**HSINCHU OFFICE**
13F-3, No. 295, Kuang-Fu Road, Sec. 2
HsinChu 300
Phone: 03-573-9900 Fax: 03-573-9169

**EPSON SINGAPORE PTE., LTD.**
No. 1 Temasek Avenue, #36-00
Millenia Tower, SINGAPORE 039192
Phone: +65-337-7911 Fax: +65-334-2716

**SEIKO EPSON CORPORATION KOREA OFFICE**
50F, KLI 63 Bldg., 60 Yoido-dong
Youngdeungpo-Ku, Seoul, 150-763, KOREA
Phone: 02-784-6027 Fax: 02-767-3677

**SEIKO EPSON CORPORATION**
**ELECTRONIC DEVICES MARKETING DIVISION**

**Electronic Device Marketing Department**
**IC Marketing & Engineering Group**
421-8, Hino, Hino-shi, Tokyo 191-8501, JAPAN
Phone: +81-(0)42-587-5816 Fax: +81-(0)42-587-5624

**ED International Marketing Department Europe & U.S.A.**
421-8, Hino, Hino-shi, Tokyo 191-8501, JAPAN
Phone: +81-(0)42-587-5812 Fax: +81-(0)42-587-5564

**ED International Marketing Department Asia**
421-8, Hino, Hino-shi, Tokyo 191-8501, JAPAN
Phone: +81-(0)42-587-5814 Fax: +81-(0)42-587-5110


In pursuit of **"Saving" Technology**, Epson electronic devices.
Our lineup of semiconductors, liquid crystal displays and quartz devices
assists in creating the products of our customers' dreams.
**Epson IS energy savings**.

# S1C62 Family
Development Tool Reference Manual

SEIKO EPSON CORPORATION
ELECTRONIC DEVICES MARKETING DIVISION

■ EPSON Electronic Devices Website

http://www.epson.co.jp/device/

First issue December, 1991
Printed April, 2001 in Japan ⓂB